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This issue of Entomologicheskoe Obozrenie contained an article commemorating the 90th anniversary of the birth of V. I. Lenin. This article has not been translated inasmuch as it does not deal with either historical details of the progress of the science of entomology in the Soviet Union or contemporary aspects of Soviet research in entomology.

# TASKS OF ENTOMOLOGY IN THE LIGHT OF RESOLUTIONS OF THE DECEMBER PLENUM OF THE CENTRAL COMMITTEE OF THE COMMUNIST PARTY OF THE SOVIET UNION*

D. M. Shteinberg and E. M. Shumakov

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The December Plenum of the C. C. of the C.P.S.U. in 1959 discussed the question of the future development of agriculture and the measures to be taken to implement the resolutions of the 21st Congress of the C.P.S.U. and the December (1958) Plenum of the C. C. on raising the level of agriculture and increasing the production of grain, sugar beet, cotton and other crops, on the improvement of stock-farming and expanding the production of meat, milk and other products, on increasing labor productivity and reducing production costs, on improving the general management of collective farms and promoting the material welfare of collective farm workers.

The Plenum heard and discussed the reports of the Council of Ministers of the R.S.F.S.R., the Central Committees of the Communist Parties of the Ukraine, Kazakhstan, Belorussia, Uzbekistan, Tadzhikistan and Azerbaijan. The Plenum noted that party organizations, soviets and agricultural bodies of the republics had devised and implemented measures for the further development of agriculture and the fulfilment of their plan quotas and commitments.

The Plenum revealed that during the short time since the 21st Congress of the C.P.S.U. great progress had been made in the development of industry, agriculture and science. The Plenum noted that the most important task of local party organizations, soviets, and agricultural bodies, collective and state farms was the expansion of grain production by at least 10-11 million poods per year, an increase which could be attained by increasing the sowings of grain crops through the cultivation of new lands, the replacement of bare fallows by green fallows in the moist zone, the replacement of low yield crops by crops giving a higher yield, and the extension of maize cultivation. The Plenum pledged itself to expand sowings and to raise the yield of sugar beet, cotton, flax and other industrial crops, and also to increase the production of potatoes and vegetables to a level sufficient to satisfy the entire needs of the country. The Plenum noted the need for further specialization in collective and state farms, particularly in market garden, fruit and berry crops, and viticulture. The Plenum recognized the need for a further increase in the productivity of stock raising and poultry rearing by the introduction of new advanced methods, which can secure an increase in the production of meat, milk, butter, and wool on every 100 hectares of farm land, and also by the setting up of special farms for the rearing of well-nourished cattle.

The resolutions of the December Plenum constitute an important new landmark in the development of the whole national economy of the country. They summon us all to make every effort in our own sphere to raise the yield of our fields, to assist in every possible way in increasing the gross yield of grain, industrial, market garden and fruit crops and the productivity of stock raising. The resolutions of the Plenum inspire us to strive for a further pronounced improvement in all our work.

N. S. Khrushchev called the December Plenum of the C.C. of the C.P.S.U. the "Plenum for the mobilization of the reserves of agriculture". This description impels us also, specialists in the field of entomology, to consider what potentialities and achievements of our science can be utilized for a further rise in the level of agricultural production.

We are well aware that one of these reserves is the protection of plants from pests, diseases and weeds.

The All-Union Institute of Plant Protection has carried out calculations which indicate what additional agricultural production our country could obtain by taking plant protection measures. Calculated on the basis of the current procurement prices and the efficiency of the measures which have been devised, an annual additional production valued at ten million roubles could be realized.

The total figure for losses amounts to approximately 13% of the cost of our country's total agricultural production, including stock raising. This figure is quite comparable with the figures for losses from pests and diseases, recently published by the FAO of UNO; this organization estimates that on a world scale agricultural pests and diseases account for 20% of the entire agricultural production. Thus, every fifth man in the world is working to no purpose — the results of his work are being filched by the elemental forces of nature.

A communist society cannot reconcile itself to such a useless expenditure of human energy. Hence we can well understand the measures which the C.P.S.U. and the Soviet government have taken in recent years to improve plant protection in our country.

*Paper read at the plenary session of the IVth Congress of the All-Union Entomological Society on January 26, 1960.

We need only mention that in recent years several large plant protection institutes have been set up in the republics – in the Ukraine, in Georgia, Uzbekistan, Kazakhstan, Azerbaijan, etc.

From the state budget the government finances the struggle against the most serious large-scale pests and diseases – such as the Colorado beetle, the shield bug (Eurygaster integriceps Put.), the grain cutworm (Hadena basilinea Schiff.) etc., and this expenditure increases from year to year. In several of the Union republics the councils of ministers have introduced special decrees on plant protection measures.

Steps are being taken to ensure a much greater supply of insecticides, fungicides and herbicides for agriculture. By the end of the current seven-year plan our country will have the necessary amounts of new preparations such as insecticides of the diene synthesis, organic fungicides, which are largely replacing the inefficient copper sulfate, various herbicides, new insecticidal organic chlorine and phosphorus compounds, as well as the necessary number of aeroplanes and land machines for their application.

The program of agriculture development for each separate Union republic, as set out in the reports of the Council of Ministers of the R.S.F.S.R. and the secretaries of the central committees of the republican Communist Parties and approved by the December Plenum of the C.P.S.U., in some degree or other touches on several entomological problems of great importance for the national economy.

History had shown us that the most serious entomological problems of national importance arise and are eliminated in line with the general development of the agricultural production of the country and thus reflect those large scale advances resulting from changes in the assortment of crops in a particular zone, the degree of concentration of single crop sowings, the introduction or, conversely, the abandonment of certain agrotechnical methods, the type of mechanization of cultivation of a given crop, and so on. With the rapid growth of our country's agriculture these changes and advances are particularly pronounced, and there is nothing surprising in the fact that entomological problems either arise unexpectedly or that the secondary problems of yesterday acquire exceptional significance and first-ranking importance today. In view of this, entomologists often have to find solutions to these problems in a very short time, to take some economic risk by recommending the adoption of measures which have not been tested on a sufficiently large scale, since the conditions of production cannot wait for the final touches to be put to recommendations. We all remember well the 1957 outbreak of the grey grain cutworm † in the zone of cultivation of virgin and long-fallow lands in the east of the country, an outbreak which covered a vast territory and damaged wheat crops over an area of more than 7 million hectares. Prior to 1957 there were only three or four published works dealing with this pest, but in the last three years we have had to organize its control on a sown area amounting to many hundreds of thousands of hectares. Thus, at the present stage of development of our agriculture we are confronted by several urgent entomological problems (1-4), which in varying degree impinge on the questions discussed by the December Plenum of the C.C. of the C.P.S.U.

1. The reports of the secretaries of the C.C.'s of the two cotton-growing republics at the Plenum raised the question of control of the cotton bollworm (Chloridea obsoleta F.) which in recent years has acquired much greater importance as a pest of cotton, maize and vegetable crops. Although fairly intensive research on this pest was carried out by the All-Union Institute of Plant Protection and other scientific institutions during 1950-1956, the numbers of this pest in these years were low and in Azerbaidzhan, for instance, entomological research workers often experienced considerable difficulty even in collecting a sufficient amount of live material for experimental purposes. However the position altered sharply in 1957, when maize, previously banned from Azerbaijan owing to its role as a reservoir of the cotton bollworm, was again introduced. Comrade Akhundov, secretary of the C.C. of the Azerbaidzhan C.P., stated in his report to the Plenum of the C.C. that the elaboration of basic control measures against the cotton bollworm was one of the urgent tasks of agriculture science. This was repeated by Comrade Ul'dzhabaev, secretary of the C.C. of the C.P. of Tadzhikistan. With the considerable increase of areas under maize in the cotton-growing republics the question of cotton bollworm control is primarily a question of combating this pest on the maize crops. Regulation of the times of harvest for silage and green fodder both of spring and stubble sowings of maize can fully ensure, on one hand, the obtention of the requisite amount of fodder and, on the other, the destruction of a considerable proportion of the stock of this pest, without the need for applying chemical control measures. Consideration must be given to the question of transferring maize production for seed outside the limits of the cotton-growing zone or into those regions of the cotton-growing republics where the cotton bollworm has no significance as a pest. In Azerbaijan, for instance, such a region is the Nakhichevan ASSR. For the protection of cotton from the cotton bollworm chemical measures must be considerably intensified. DDT and BHC must be gradually replaced by more effective preparations, among which, from experiments in 1959, particular promise has been shown by Sevin (N-methyl-α-naphthylcarbamate) – a preparation which is still not in production in our country, although its production apparently presents no great difficulties. For increasing the effectiveness of cotton bollworm control, strict regulation of the times of dusting the crops is absolutely essential, with due regard being taken of the phenology of different broods of the pest, and it is desirable that such instructions should be issued by a centralized body on the scale of a republic or region.

† [Presumably Hadena anceps Bkh.–(Translator)].

It must be noted that research on cotton bollworm control in republican plant protection institutions is, unfortunately, extremely inadequate.

2. In connection with the recent resolution of the Council of Ministers of the USSR on the production of high quality "hardy" and hard wheats the problem of control of the shield bug (Eurygaster integriceps Put.) has assumed a new aspect. During the last decade an effective control system against this pest has been devised. Chemical control measures against the bugs provide effective protection of the harvest from direct losses. Every kilogram of DDT or Vofatox preparation employed for shield bug control is compensated for by an average additional yield of 20 kg of grain. Every year tens of thousands of tons of these preparations are expended in shield bug control. The chemical measures and, in particular, the changeover to two-stage harvesting within a restricted period have resulted in the elimination of mass outbreaks of the shield bug in several regions (Voronezh, Penza, Belgorod, etc.), while in others, for instance Krasnodar and Stavropol Territories, and Kuibyshev Region, the density of the pest on crops has been considerably reduced. However, in spite of this, the percentage of damaged grain in the harvest is still quite considerable, and hence the condition of the grain is not good enough.

Along with the other requirements which a wheat harvest must satisfy before it can be considered as "hardy", damage to the grain by the shield bug must not exceed 0.5%. An experiment conducted by the All-Union Institute of Plant Protection in 1959 on the collective farm "Rossiya" in Stavropol Territory showed that for this the effectiveness of shield bug control had to be such that the numbers of larvae before harvest must not exceed one per sq m. The experience of the collective farm "Rossiya," as well as of other farms in Krasnodar and Stavropol Territories, shows that this is quite possible to attain by thorough and timely conduction of the existing system of measures against the shield bug. When the measures are not sufficiently thorough the system does not provide a due effect. It should be pointed out that the fulfilment of the conditions required for the obtention of "hardy" and hard wheats, raises the procurement price for the harvest by 40%, and hence the obtention on a country-wide scale of a wheat harvest free from significant admixtures of bug-damaged grain becomes a problem of great economic importance.

3. In the resolutions of the December Plenum considerable attention was given to questions of the protection of the orchard harvest. Provision is being made for the organization of specialized state farms and the specialization of individual collective farms for the production of fruit, berries and grapes. These measures will undoubtedly increase the importance of protection of our orchards from pests and diseases.

No other branch of agriculture provides such a high economic return for plant protection measures as fruit-growing and viticulture. As the experience of advanced farms has shown, very large harvests of high value may be obtained as a result of these measures. In the state farm "Sad-Gigant" in Krasnodar Territory, on an experimental plot where protection measures were conducted under the guidance of the All-Union Institute of Plant Protection, one brigade of the state farm obtained a yield of 500 kg of high-quality apples from every tree on a four hectare area, the value of the harvest from each hectare of the experimental plot being expressed by a figure of 250,000 roubles, and the net profit about 200,000 roubles. This yield, obtained when severe epiphytotic scab was prevalent, shows what inexhaustible potentialities our fruit growing possesses as regards raising the yield of orchards through the control of pests and diseases.

Further elaboration and the wide adoption of measures to protect orchards and vineyards from pests will enable us to raise our fruit growing to one of the foremost positions in the world, but for this our attention will have to be concentrated on the economics and technique of the chemical method of protecting orchard plantings.

4. There are many other problems of agriculture entomology which we cannot deal with fully here, and we must confine ourselves solely to listing some of them. With the changeover of several crops to square-cluster sowing with a fixed amount of seed, wireworm control emerges as a very important problem. In this connection we must develop and widely adopt the practice of introducing soil insecticides – a measure which is being used in practice on a very small scale at present. The significance of wireworms as pests will obviously be very great also in south Siberia, on forest areas marked down for cultivation in the next seven years, and local entomologists must be prepared to solve this problem.

For more than ten years our country has managed to hold off the invasion of the Colorado beetle on its western borders. Owing to the situation arising from the multiplication of this pest in the zone of Poland, Czechoslovakia and Hungary bordering the USSR, the yearly threat of introduction of the beetle by flight over the frontier has become much greater within the last two years. In 1959 there was a considerable number of beetles of local origin in the Transcarpathian Region of the Ukr. SSR. Entomologists in the western regions and republics of the USSR must take every measure to ensure that the barrier to the Colorado beetle on our frontier is not penetrated.

As another aspect of the great tasks confronting agriculture, we must also trace out the main lines of the further development of scientific thought in the sphere of entomology. We cannot, of course, deal fully with all problems. We have tried to note only the most important questions. We must bear in mind that some of them are immediate problems demanding urgent attention at the present time (1-5); others are, to use the phrase of A. N. Nesmeyanov, President of the Academy of Sciences, USSR, the scientist's department, problems to which thought must be given, into which research must be made, and which

will probably assume their full importance later. We will start with the first group.

1. It is well known that every year the lists of crop pests are supplemented with more new names, some even new to science. This arises from the fact that the continuous advance of agriculture as a whole cannot be itself completely eliminate the destructiveness of pests. New conditions of the agricultural environment may restrict the development of some pests, but at the same time create a favorable background for the development of others. In the fauna of each geographical region there is always a large and diverse assemblage of species and forms of animals, potentially capable of changing over to cultivated plants either by long adaptation or by the relatively rapid formation of new biological races. Unfortunately, our knowledge of the natural groupings of insects, and even of their species composition in many regions, is still so unsatisfactory that we cannot at present foresee all the possible cases of changeover of new wild species to crops, or sudden increases in the numbers of individual species, previously regarded as having no economic significance. In view of this we can state quite definitely that further knowledge of the insect fauna of the Soviet Union is not only a task of theoretical entomology, directed toward the construction of a system of insects, but also a problem of direct agricultural import.

2. Specialization of farms for the cultivation of particular crops is becoming more and more important now. Concentrations of a single crop, however, create special conditions for the development of insects associated with it, and frequently lead to greater concentrations of pests on the fields. The majority of agrotechnical methods of pest control, whether aimed at prevention or extermination, are based on a particular crop rotation. The spread of single crop cultivation gives rise to the problem of devising new measures to protect crops from pests and diseases, measures which will prevent the increase of pests in the new conditions. This problem is becoming particularly acute in the cultivation of grain crops, particularly maize, and also in vegetable growing.

3. The chemical method is still the main instrument for actively controlling the number of pests. Hence, further work on all aspects of the production and technique of application of new insecticides is essential, with due regard being taken both of the beneficial and adverse aspects of the large-scale employment of chemical poisons. The main trends of scientific thought must be directed toward the synthesis of more effective substances, a considerable extension of the range of chemical poisons in use, research on the mechanism of their action on pests and plants, and investigations of the effect of chemicals on biocoenoses as a whole.

One of the most important tasks is to work out ways of applying chemicals so that they can be combined effectively with other methods of pest control – agrotechnical, biological, etc. There is no doubt that the whole plant protection system of the future must be based on measures which rule out in advance the possibility of large-scale multiplication of injurious species of insects. Such a system cannot be constructed on chemistry alone. It must rest on the theoretical resolution of questions concerning ways of controlling the internal links and relationships within biocoenoses. Unfortunately, at present we are lagging behing in our theoretical treatment of such questions as population dynamics, host-parasite relationships among entomophages and their victims, the effect of various insecticides on natural groupings, ways of increasing the efficiency of entomophages, etc. We have no satisfactory economic indices which can provide us with an objective picture of the destructiveness of pests and the economic advantage of applying particular measures.

Questions of the biological method of control have particular significance here. Studies in this field of plant protection are badly organized in our country and have not yet been provided with a satisfactory productive base. Special attention must be given to research on methods of increasing the efficiency of entomophages either by increasing the numbers of local species, or by introducing new species or by transferring them within their range.

4. Extensive research on the biological adaptability of insects, primarily injurious species, is of very great importance. It is well known that when new preparations are introduced, new, resistant forms of insects develop. The changeover of insects to other crops is another aspect of the same process. The study and discovery of the biological laws underlying the adaptability of insects constitute a complex theoretical problem which arises, however, out of direct practical necessity.

5. As an aspect of the more far-reaching and conscious influence of man on the living nature surrounding him, questions of the active control of insect ontogeneses are becoming more and more important. At present these questions are being dealt with mainly in the case of such useful species as the mulberry silkworm or the Chinese oak silkworm, or in the case of ways of affecting resting diapausing stages. These studies, apart from their great theoretical interest, will undoubtedly open up new perspectives in the practical employment of particular methods for deliberately altering the life cycles of various species.

All the lines of research listed above are already recognized at present and research along such lines is being carried out in varying degrees. We must continue to develop these researches as far as possible, we must endow them with more practical point, and be bolder in separating out the most significant, particular practical problems from the more general ones. However, besides these and other such problems there are also, in our opinion, several problems to which thought must be given, which are still not material at present, but which will crop up in the near future and for dealing with which we must gradually prepare ourselves (1-3). Of course, it is difficult at present to foresee all the problems which may arise in the future. But we think it necessary to say a few words at least about some

of them, which are fairly apparent at present, although their practical aspects are still not very obvious.

1. There is the development of methods of mathematical analysis in plant protection work, particularly the introduction of cybernetics for this purpose. It is obvious to every one that the use of the methods of cybernetics has given quite outstanding results in various branches of knowledge. Owing to several specific difficulties, cybernetics is only beginning to penetrate into biology. We must certainly give serious thought to ways of utilizing it in entomological problems.

2. Our country is in the forefront as regards the peaceful utilization of atomic energy. Radioisotopes are now finding wide application in zoological research work, including research on insect biology. Yet the sphere of possible utilization of ionizing radiation in future will undoubtedly be much greater, and will directly embrace questions of pest control. This is already happening in practice in the case of storehouse pests. The use of insects as indicators of contamination of a locality by radioactive substance and the possibility of eliminating harmful isotopes by their accumulation in the insect organism, a question which has received some study in recent years – all these and similar problems must occupy a greater part of the program of scientific research.

3. At present most insects are considered as a potentially injurious factor of nature; on the whole, only an insignificant number of useful insects is used in sericulture, apiculture, biological control, or for certain special technical purposes. We know, however, that the insect organism sometimes accumulates or produces elements or compounds useful to man. Plant biochemistry, the purpose of which is to utilize plants as useful resources, has advanced broadly in recent times. Insect biochemistry is still in an embryonic state. Yet it is very probable that many insects could be used as a source of chemical substances useful to man. This opens up hitherto undiscovered fields of research. Insects as biological industrial resources are still completely unknown.

We could certainly add to the list of such important problems which await research in the future. For lack of time we have not discussed several scientific problems, such as the question of quarantine, the acclimatization of entomophages, and so on. Moreover, we have deliberately refrained from a separate treatment of agricultural and medical problems in the field of entomology in the belief that our more general statements will have validity both in the sphere of plant protection and in questions of the control of bloodsucking disease vectors.

Our organizational tasks arise, as we indicated above, from the need to develop research along such varied and important lines. First of all, there is the question of coordination. To ensure that individual teams are not left out of complex combined research, that there is an exchange of information on the progress of research, that there is no duplication of work, and, on the other hand, that results obtained in one place may be effectively checked in other conditions, requires an effective coordination of work both on general and more specialized problems. Unfortunately, despite the numerous congresses and conferences, coordination of work in the sphere of entomology is still badly organized in our country. Formally it appears quite clear: All questions of agricultural and forest entomology are coordinated by the plant protection sections of the All-Union Institute of Plant Protection, which convene on annual planning and methods conference; questions relating to the study of insect fauna are coordinated by the Zoological Institute. But even this formal coordination is inadequate, since the Institute of Plant Protection mainly embraces agricultural institutions, and the Zoological Institute – academic institutions, while the higher educational institutions lie largely outside the embrace of either system. Interdepartmental coordination is practically nonexistent. But the whole system of coordination appears even worse when we look at it in practice, and not as it is on paper. As regards the overwhelming majority of questions there is merely a recording of what is being done in one department or another. Owing to the divorce of the academic institutions from agricultural ones, there is no proper liaison on theoretical research. There ought to be effective coordination on some, relatively narrow, problems; the subject might either be a particular pest, or a problem which can be solved by comparative work on different material. Such attempts have been made both on the part of the Institute of Plant Protection, as well as on the part of the Zoological Institute: For instance, all-union plans were made for such problems as the Colorado beetle, the bollworm Gelechia malvella Hb., the forest pest Dendrolimus sibiricus Tschtw. etc., and tasks were allotted, but after that the efficiency of organization was usually only sufficient to implement the plan for one season. Meanwhile, we are convinced that it is all-union teams, with members located in different parts of the USSR and in communication with one another, which should solve a common problem and should effect the whole system of coordination.

It seems to us that our All-Union Entomological Society can make an important contribution to the problem of coordination. Both the Council of the Society and the committees of its branches can make their meetings a platform for the discussion of scientific problems with reference to the need for their coordination. The Society is precisely that interdepartmental organization which is entitled to raise its voice on behalf of an extensive scientific community and to assist in the organization of coordinated scientific research.

Another very important problem of organization is that of personnel recruitment. Both in quantity and, in particular, in quality, the training of entomological personnel at present lags behind the demands of the national economy. The number of young entomological specialists produced annually by all our universities, agricultural, forestry, and veterinary institutes, barely makes up for the natural loss of personnel. We are convinced that the closing of IZIF

was an unjustifiable act on the part of the Ministry of Agriculture, USSR: It resulted in the disruption of an established system of training personnel in agricultural entomology, a system which had been in existence for almost 40 years.

Requests for students finishing university come mainly from the Ministry of Health; the Ministry of Agriculture is apparently not particularly concerned about personnel for plant protection. And yet the development of our great agriculture insistently demands the presence of plant protection specialists in collective and state farms, specialists which managers of collective and state farms would not divert to other agronomic problems. The creation of regional plant protection stations and corresponding sections in zonal experimental stations also requires numerous new recruits.

We cannot fail to note that as regards the training of personnel, department interests are still deeply involved. For instance, the Ministry of Health, USSR and the Veterinary Board of the Ministry of Agriculture, USSR believe that personnel for medical and veterinary entomology must receive separate training for each ministry. Yet it is quite obvious that medical and veterinary entomology are so closely linked, the vectors of infectious disease of man and domestic animals—the principal objects of study—are common or very similar, and hence the training of personnel in both fields could be carried out under a single plan and with common study programs.

When we consider all our most experienced entomologists, we note the great preponderance of systemic entomologists. There is no doubt that work in the field of faunistics and systematics demands narrower specialization and hence a greater number of specialists. The example of some of our specialists in agricultural and forest entomology who are at the same time experts on the systematics of large groups of insects ought to serve as a model of emulation for the young, rising entomologists.

It is very important to bear in mind that our country can achieve a solid front of science and practice in the field of entomology. We can and must throw more powerful shock groups into the solution of particular current problems but we have no right to denude other sectors in doing this, although such sectors are not rated of primary importance at the present time. We lag behind in the treatment of such questions as insect physiology in general, and endocrinology in particular, in the study of population dynamics, in the development of biological control of insects, and so on.

The All-Union Entomological Society can play an important part in questions of training of personnel and in their specialization. At the scientific meetings of the Society we do not usually discuss organizational questions relating to the training and distribution of personnel. Yet the voice of the scientific community in these questions is often valued very highly.

On the threshold of the second year of the seven-year plan our Society enters on the second century of its existence. The fulfillment of the seven-year plan and the implementation of the resolutions of the December Plenum of the C.C. of the C.P.S.U. confront us with immense tasks relating to production, research and organization, and compel every Society member to do his utmost to take an active part in this great work. This is all the more important at the present moment, when public organizations, including scientific societies, must play an ever-increasing role in the life of our country.

# EMBRYONIC DEVELOPMENT OF Angitia vestigialis Ratz. (HYMENOPTERA, ICHNEUMONIDAE) – AN INTERNAL PARASITE OF THE SAWFLY PONTANIA CAPREAE L. (HYMENOPTERA, TENTHREDINIDAE)

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While collecting material for a study of the development of the sawfly Pontania caprea L. in the grounds of Petergof Biological Institute, I found that more than half of the larvae of this sawfly were infested by some internal parasite. This parasite was identified as Angitia vestigialis Ratz. by G. A. Viktorov. I take this opportunity of expressing my thanks to G. A. Viktorov.

I could find no information on the embryology of Angitia in the literature; of the other Ichneumonidae the embryonic development has been described only in the case of Banchus femoralis Thoms. (Bledowski and Krainska [1926]) and Pimpla turionellae (L.) (Bronskill [1959]), and there is also a rather old and incomplete account of the development of Mesochorus confusus Holmgr. (Kulagin [1894]). Hence I made use of the opportunity provided to collect some A. vestigialis material, and this paper contains the results of the examination of this material.

In 1954, 73.5% of the Pontania larvae were infested by Angitia (out of 313 larvae opened up 230 were infested), while in 1955 infested Pontania larvae constituted 54.4% (out of 241 larvae opened up, 131 were infested). The sawfly larvae are attacked by the ichneumon immediately after they emerge from the egg. Fig. 1, A illustrates a first instar Pontania larva, only recently hatched out, as is evinced by the large size of the head capsule in comparison with the body. In the body cavity of this larva, to the right of the gut, the Angitia egg can be seen shining through. Angitia eggs can be found also in second-instar Pontania larvae, but larvae of the later instars are apparently not attacked – only Angitia larvae are found in them.

Usually only one Angitia egg is laid in one Pontania larva, but sometimes two, three or even four eggs of the parasite are present in one larva. These eggs may be at different stages of development, thus indicating that they were laid at different times and by different female sawflies, or they may be at exactly the same stage of development, and it may be assumed that they were all laid by one female at one time.

Angitia larvae, however, usually occur singly. Even in the few cases when the opening of a Pontania larva revealed two Angitia larvae present at once, one of them was found to be dead. Obviously larval cannibalism occurs in A. vestigialis, as in A. fenestralis Holmgr. (according to Meier [1925]) and many other ichneumons.

Pontania larvae infested by the ichneumon appear quite healthy. Sections prepared from infested larvae showed no defensive reaction of the host tissues to the presence of the parasite (Fig. 1, B).* At the end of summer the infested sawfly larvae, just like the healthy ones, leave their galls and migrate into the soil, where they weave their cocoons. It is not clear if they manage to molt to the pupal stage. Some of the sawflies and their parasites emerge from the cocoons in August while the rest overwinter. By keeping Pontania cocoons (collected

*Symbols for Figs. 1-9:

| | |
|---|---|
| ao | - anal opening |
| bl | - blastoderm |
| vnc | - ventral nerve-cord |
| labr | - labrum |
| b | - brain |
| yc | - yolk cells |
| ys | - yolk syncytium |
| hg | - hindgut |
| lg | - labial glands |
| max | - maxilliary rudiments |
| mand | - mandibular rudiments |
| mes | - mesoderm |
| ment | - mesentoderm |
| mv | - Malpighian vessels |
| lab | - labium |
| gr | - genital rudiment |
| proct | - proctodeum |
| ser | - serosa |
| dv | - dorsal vessel |
| mg | - midgut |
| stom | - stomodeum |
| tr | - tracheae |
| ch | - chorion |
| em | - Angitia embryo |
| ent | - entoderm |

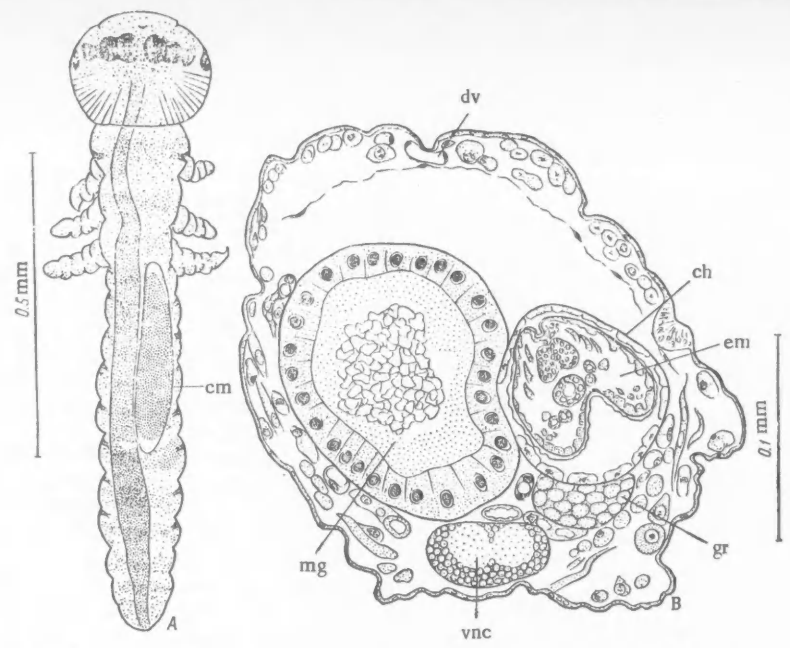


Fig. 1. A) First-instar larva of Pontania capreae L. infested by Angitia vestigialis Ratz., B) transverse section through an infested larva of Pontania capreae L.

in September) between the window frames, I managed to obtain adult Pontania and Angitia in March.

The eggs of A. vestigialis are approximately cylindrical and slightly bent. The ventral side is more convex, the dorsal concave. The fore end of the egg is a little broader than the hind end (Fig. 2,A). Outwardly the egg is covered by a fine chorion which is easily penetrated by methylene blue, neutral and red fixatives. However, for the preparation of whole mounts stained with Boehmer's hematoxylin and for paraffin imbedding, the chorion has to be pierced.

The youngest, newly laid eggs are 0.3 mm long and 0.05 mm broad. As the embryo develops, the linear dimensions of the egg are approximately doubled, while its volume becomes eight times greater (Fig. 2). Evidently absorption of the host's cavity fluid takes place, and perhaps of some of the substances dissolved in it.

There is no yolk in the egg of Angitia, but the protoplasm of the egg contains pale vacuoles, the contents of which stain neither with acid, nor with basic stains (Fig. 3,A). The vacuole contents do not become black on fixation with Flemming's fluid and subsequent treatment with $Na_2S$. After this treatment the eggs of Angitia reveal only an insignificant amount of fat in the form of a very fine granularity. At the blastoderm stage this granularity is located in a layer immediately below the blastoderm nuclei, i.e., in the protoplasm of the inner ends of the cells.

During cleavage there is a separation of the protoplasm and vacuoles: The protoplasm is concentrated round the nuclei and migrates along with them to the surface of the egg, while the vacuoles coalesce and form a large space filled with watery fluid in the center of the egg (Fig. 3,B). The absence of yolk and the formation of a cavity containing watery fluid inside the embryo have been described by Kulagin [1894] for Mesochorus. The nuclei which emerge at the surface of the egg are arranged in one layer and form a blastoderm. Some nuclei with portions of protoplasm surrounding them remain in the central cavity of the egg, where they form small, apparently syncytial groups. These are the yolk cells. The groups of yolk cells show no tendency to accumulate in any particular part of the egg, but are dispersed throughout the whole central cavity. They are connected to the blastoderm and with one another by fine protoplasmic strands and appear as if in a suspended state.

The yolk cells of insects in which the eggs are rich in yolk usually become specialized as vitellophags at an early stage. In many parasitic Hymenoptera there is no yolk but the yolk cells still form as a rudiment, and then rapidly degenerate. I have had occasion to observe this in Prestwichia aquatica Lubb., Caraphractus reductus R.-Kors. and Ephedrus plagiator Nees (Ivanova-Kazas [1950, 1954, 1956]). In Angitia, as distinct from these, the yolk cells retain their embryonic character for a long period. A comparison of Figs. 3,B and 3,C shows that as the blastoderm cells increase in number and become smaller, the same thing happens with the yolk cells, and hence it follows that at the blastoderm stage they are still capable of reproducing.

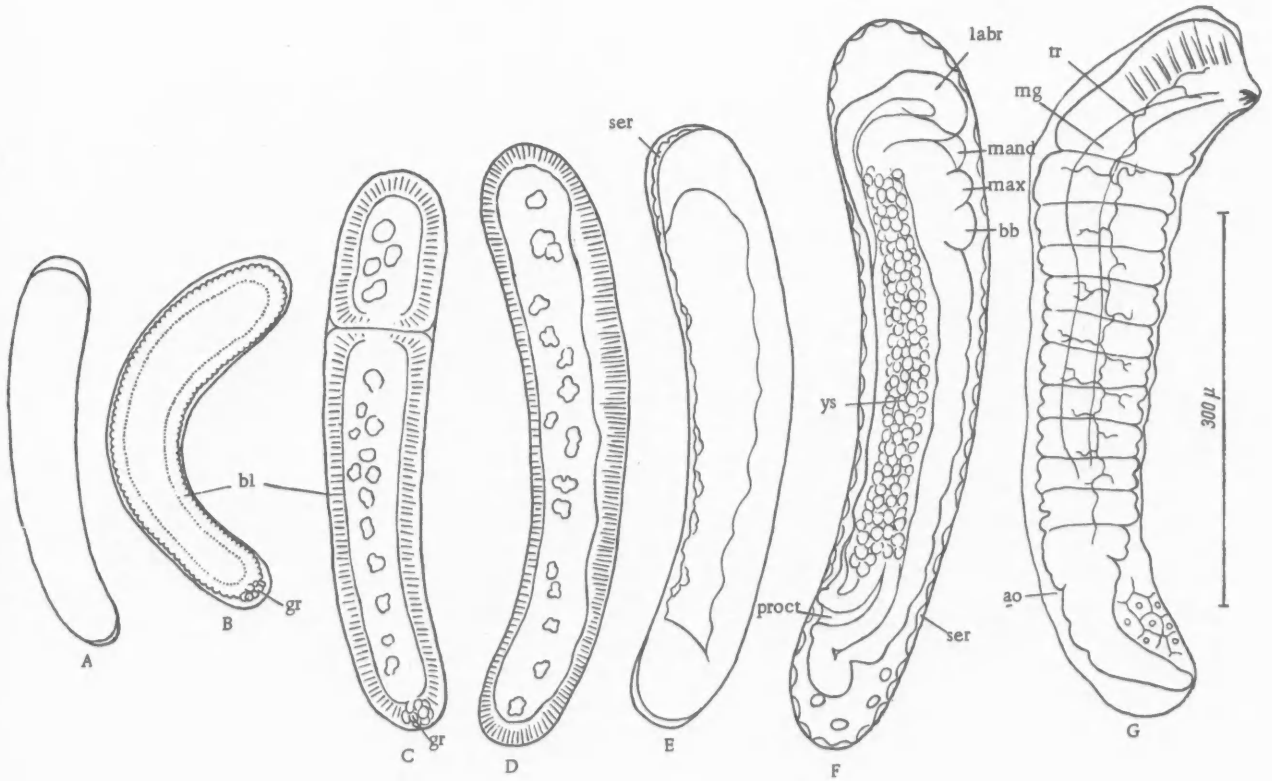


Fig. 2. Embryos of Angitia vestigialis Ratz. at different stages of development (A - G; drawn from life).

At the hind end of the embryo a group of round cells, which do not form part of the blastoderm, can be distinguished (Fig. 2,B). These are the pole cells or the genital rudiment. Later the genital rudiment sinks into the blastoderm and cannot be distinguished so clearly (Fig. 2,C). At a still later stage the cells of the genital rudiment lie under the blastoderm (Fig. 4).

Both in living eggs and in fixed eggs at the blastoderm stage, I had occasion to observe a transverse constriction (Fig. 2,C). It could be found at different levels; its significance still remains obscure.

The thickness of the blastoderm at first is exactly the same in all parts of the egg (Fig. 2,B and C, Fig. 3,B and C), but then the ventral blastoderm becomes thicker, and the dorsal thinner (Fig. 2,D and 3,D). In the midventral part of the blastoderm the regular one-row arrangement of the nuclei is disturbed; the process of gastrulation is under way here. An interesting feature is the lack of any strict correspondence between the processes of cell multiplication and differentiation. Sometimes differentiation begins when the cells are still comparatively large and few (Fig. 3,D). In other cases the cells continue to multiply for a longer time without any outward signs of differentiation (Fig. 3,C). This heterochronia, having the nature of individual variations, occurs rather often and deserves attention; it is possible that this heterochronia, as well as other variations of development, underlie the evolution of embryogenesis.

In the fore part of the embryo the cells begin to move inward and produce a cell mass, which we will call the mesentoderm, since it was impossible to distinguish the entoderm and mesoderm rudiments (Fig. 4,A). In the blastoderm one can soon distinguish a thick germband, which occupies the whole ventral side and curves round to the dorsal side at the fore and hind ends, and a dorsal region of thinner extraembryonic blastoderm (Fig. 2,E). In sagittal sections (Fig. 4,B) at this time the germband cells are seen to be arranged in several rows; the germband is particularly thick at the hind end, where the proctodeum subsequently develops. The formation of the mesentoderm now proceeds over the whole ventral side of the embryo. As transverse sections reveal (Fig. 6), the emigration of cells from the blastoderm occurs along the midventral line but the primary groove in Angitia is weak. The formation of the mesentoderm is particularly rapid at the fore end — here the ingrowth of a large cell mass (Fig. 6,A) is completed straight away. In general, the mode of production of the mesentoderm from the blastoderm in A. vestigialis is more primitive and typical for insects than in Mesochorus, for which Kulagin [1894] described a morular delamination, or in Pimpla, in which the mesoderm rudiment is epithelized (Bronskill [1959]). In Banchus femoralis the mesoderm is formed as a result of tangential divisions of cells in the ventral part of the blastoderm (Bledowski and Krainska [1926]).

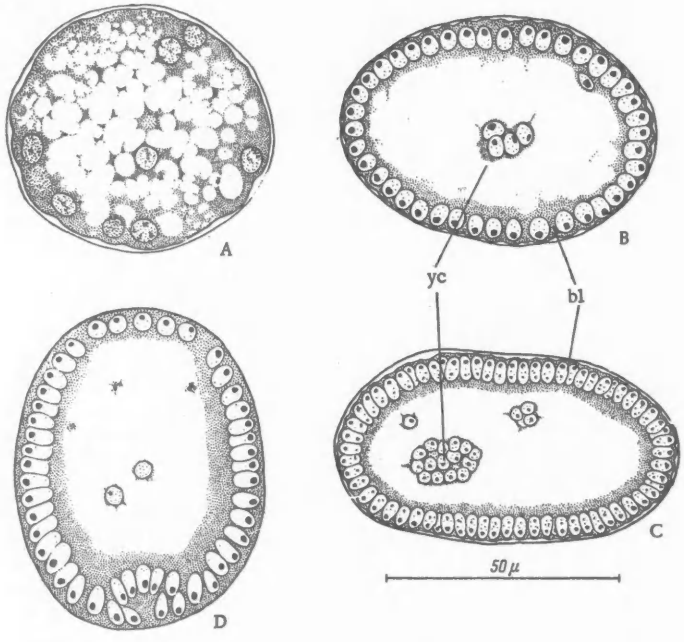


Fig. 3. Embryo of Angitia vestigialis Ratz. in transverse sections. A) Start of blastoderm formation; B and C) uniform blastoderm; D) stage of non-uniform blastoderm.

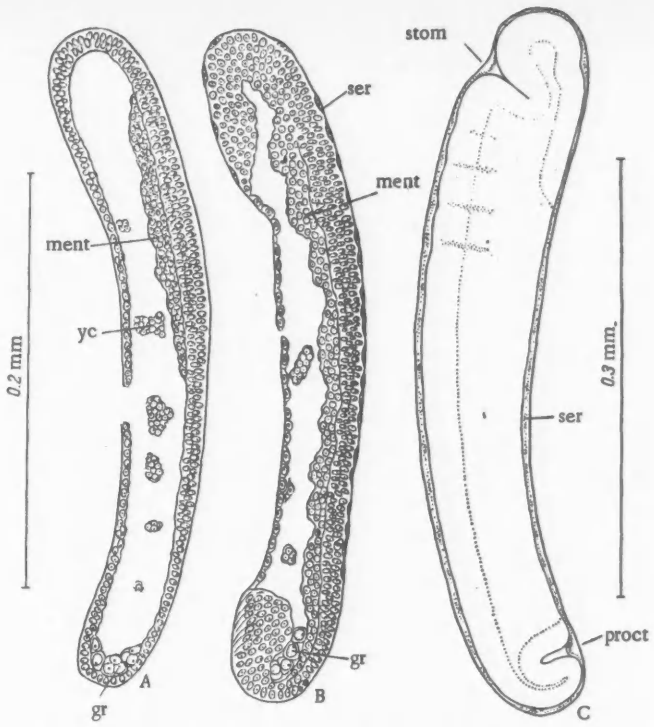


Fig. 4. Angitia vestigialis Ratz. A) Start of mesentoderm formation in sagittal section; B) formation of serosa in sagittal section; C) start of segmentation (whole mount).

At the same time the formation of the embryonic membrane (serosa) takes place. The thin blastoderm on the dorsal side of the embryo separates anteriorly from the edge of the germ-band and begins to grow over it (Fig. 2,E). The same process occurs on the sides of the embryo (Fig. 5). This process begins at the front and spreads backwards. Hence at the hind end the embryonic and extraembryonic blastoderm remain connected with one another longest and the hind end remains uncovered by the serosa for a longer time. The fully developed serosa has the form of a sac closed on all sides (Figs. 2,F, 6 and 7, A); there is no trace of an amnion in Angitia.

This mode of serosa formation (without amniotic folds or amnion itself) by the serosa rudiment separating from the germ-band and overgrowing it, is of rather frequent occurrence in the aculeate Hymenoptera. This is the way the membrane develops in Vespa vulgaris L. (Strindberg [1914]), Formica (Strindberg [1913]) and the honey bee (Nelson [1915]). In Chalicodoma muraria F. (Carrière und Bürger [1898]), Ammophila campestris Jur. (Baerends and Baerends-van-Roon, [1949]) and in Scolia quadripunctate F. (Dondua [1953]), a rudimentary amniotic fold is formed, but shortly after this the amnion rudiment degenerates, and the freed edge of the serosa grows over the germ-band. In parasitic Hymenoptera this mode

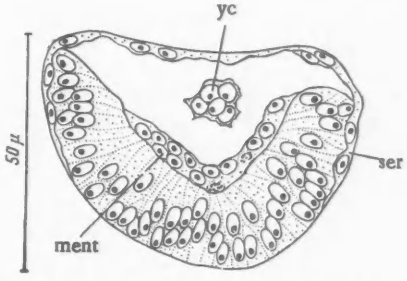


Fig. 5. Formation of serosa in Angitia vestigialis Ratz. in transverse section.

of formation of the embryonic membrane has been observed only in Eurytoma aciculata Ratz. (Ivanova-Kazas [1958]) and in Pimpla turionellae (L.) (Bronskill [1959]). In other representatives of this suborder a single embryonic membrane, which I consider homologous with the serosa, is formed either by delamination during the formation of the blastoderm (Mesochorus and Platygaster instricator, according to Kulagin [1894]; Ephedrus plagiator Nees, according to Ivanova-Kazas [1956]), or from some of the blastomeres during cleavage (many Platygasteridae, according to Marchal [1906]; Aphidius, according to Ivan-

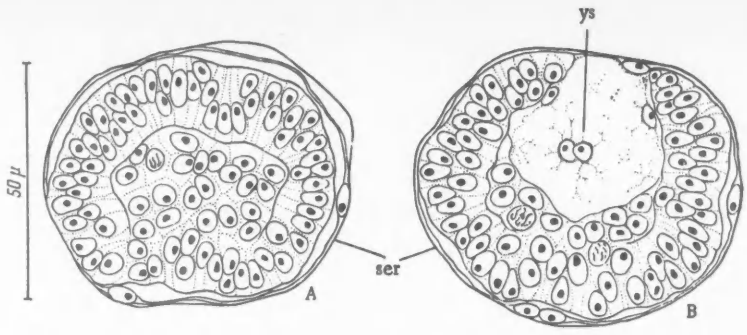


Fig. 6. Two transverse sections through germ-band of Angitia vestigialis Ratz. A) near fore end; B) in middle of embryo.

ova-Kazas [1956]), or, finally, even before cleavage begins, from the peripheral layer of protoplasm, where the nuclei of the directing bodies are found (polyembryonic Encyrtidae and Platygasteridae, according to Martin [1914]; Leiby [1929], and others). Thus, the mode of development of the serosa in A. vestigialis must be considered as primitive for parasitic Hymenoptera. At the same time it must be noted that in several parasitic Hymenopters (including Banchus femoralis, according to Bledowski and Krainska [1956]) no embryonic membranes at all are formed.

In the hind part of the germ-band, where it bends round to the dorsal side, a small proctodeal invagination appears. Shortly after this the stomodeum develops at the fore end (Fig. 4,C), in approximately the same region where the mass ingrowth of cells had taken place before.

At the same time segmentation of the embryo begins. The first intersegmental furrows apparently demarcate the labial and first thoracic segment (Fig. 4,C). Then segmentation extends over the whole germ-band. In later embryos (Fig. 2,F) one can distinguish at the front end a large unpaired lobe, overhanging the mouth opening and corresponding to the labrum, three postoral head segments, giving rise to pairs of small swellings (rudiments of mouth parts), and a number of body segments.

By this time the serosa now covers the embryo completely. The serosa and chorion stretch, so that between the embryo and these membranes there arises a fairly large free space (Fig. 2,F). The cells at the free edges of the germ-band flatten and move on to the dorsal side, thus bounding the body of the embryo dorsally. The dorsal body wall formed in this manner is like a very flat epithelium at first, and then its cells become cubical.

The stomodeum and proctodeum became deeper. The formation of the midgut begins. By the last germ-band stage the yolk cells do not form such dense clumps as at the blastoderm stage, but are dispersed singly in the space bound ventrally and laterally by the germ-band and dorsally by the serosa. They still retain a connection with one another through protoplasmic connectives, and form a reticular syncytial mass (Fig. 6,B). At the surface this syncytium is fairly clearly demarcated by a fine protoplasmic layer, close to which most of the yolk nuclei lie. Only a few yolk nuclei remain in the center. This syncytium apparently duplicates the structure formed by the yolk cells in insect eggs which are rich in yolk, for instance, in Eurytoma aciculata Ratz., but the yolk, which normally lies in the meshes of the syncytial network, is absent in Angitia. In living embryos this syncytium looks like a mass of foam (Fig. 2,F).

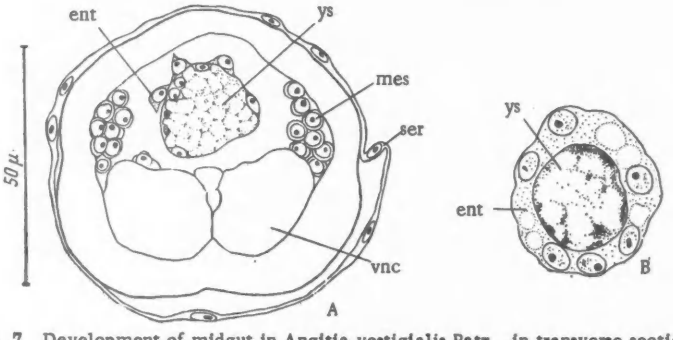


Fig. 7. Development of midgut in Angitia vestigialis Ratz. in transverse sections. A) deposition of entodermal cells on surface of yolk syncytium; B) fully formed midgut.

A little later individual cells are deposited at the surface of the yolk syncytium and then they coalesce to form the continuous wall of the midgut (Fig. 7,A and B). Thus, the yolk syncytium acts as a base for the formation of the midgut epithelium – in the same way as the yolk mass in eggs rich in yolk. The cells forming the midgut soon increase in size and large vacuoles appear in their protoplasm; the cell boundaries cannot be distinguished. After this the yolk syncytium, enclosed within the midgut, degenerates and is digested.

What is the origin of the cells forming the midgut in Angitia? Usually the midgut (entoderm) rudiment of insects develops bipolarly at the fore and hind ends of the germ-band simultaneously with the mesoderm or independent of it. More often the entoderm is formed later than the mesoderm by the proliferation of cells from the bottom of the stomo- and proctodeum. However, in Angitia nothing resembling such proliferation is observed.

In Mestocharis militaris R.-Kors. (Ivanova-Kazas [1952]) the formation of the mesoderm takes place over the whole length of the germ-band. At the same time there is a very extensive ingrowth of cell material at the fore end, and this provides the wall of the midgut. In Angitia, as already noted, the formation of the inner mass of cells is more rapid at the fore end. It is very tempting to assume that it is here that the entoderm is laid down. However, there is no evidence for this. In Mestocharis the entoderm grows over the yolk in a solid mass. Here the midgut is formed from cells dispersed over the whole surface of the yolk syncytium, and which apparently separate from the mesentoderm over the whole length of the embryo.

A similar mode of formation of the common rudiment of entoderm and mesoderm was noted also in Eurytoma aciculata Ratz. (Ivanova-Kazas [1958]) and in some ants (Strindberg [1913]).

Later organogenesis does not present any special features. From the thickened ventral part of the embryonic ectoderm the rudiment of the ventral nerve-cord is differentiated. From the dorsolateral regions of the fore end of the germ-band the material of the supraesophageal ganglia is separated. By the end of embryonic development the nervous system is already well developed, fibrous matter can be distinctly seen within the ganglia, and the circumesophageal connectives between the brain and ventral nerve-cord are formed.

From the deep part of the proctodeum two invaginations extend forward, each of which soon becomes doubled. In this way four tubular Malpighian vessels are formed. The hind gut itself remains short and forms a bulblike swelling (Fig. 8,C). The mid- and hindgut are not connected, a characteristic feature of parasitic Hymenoptera. The part of the embryo located behind the proctodeum is produced into a fairly long tail appendage. The anal opening retains its initial dorsal position. At the fore end a pair of labial glands is formed.

From the embryonic mesoderm the numerous muscles of the head and body are differentiated. The muscles extending from the esophagus to the dorsal side of the head have a distinct transverse striation. Above the gut the dorsal vessel is formed. Some of the mesoderm cells remain undifferentiated till the end of embryonic development – this is evidently the rudiment of the fat body.

The epidermis secretes a fairly thick cuticle, particularly dense in the head capsule. The mandibles acquire the form of two sharp, weakly bent spines. All traces of head segmentation disappear. In the body the boundaries of the segments remain very distinct. Besides this, each segment is subdivided into two rings by a transverse constriction (Fig. 2,G). These constrictions are temporary formations – creases due to the compression of the embryo within the membranes. When the larva hatches these creases smooth out, and the volume of the larva becomes appreciably greater (Fig 8,B). A highly ramified tracheal system can be seen through the integuments of the embryo. The genital rudiment assumes the form of two oval groups of cells, covered by a connective tissue membrane and lying in front of the hindgut.

In Angitia the serosa membrane remains till the end of embryonic development. The serosa cells become thicker (Fig. 9,A). In their cytoplasm there appear pale vacuoles and tiny granules, demonstrable on fixation with Flemming's fluid (Fig. 9,C). The boundaries of the individual cells, indistinguishable at the earlier stages, now become distinct. The connection between the cells becomes weaker, so that appreciable gaps appear between them (Fig. 9,B). One gets the impression that the serosa cells only retain their epithelium-like arrangement because they lie tightly against the chorion.

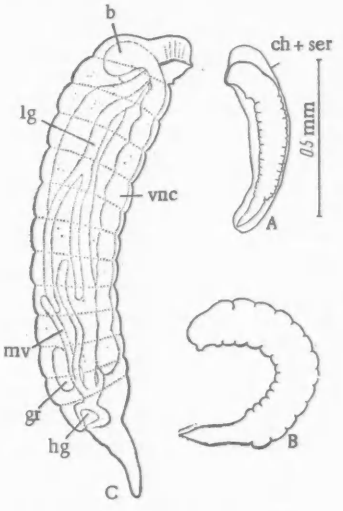


Fig. 8. Late embryo (A) and first-instar larva (B and C) of Angitia vestigialis Ratz.

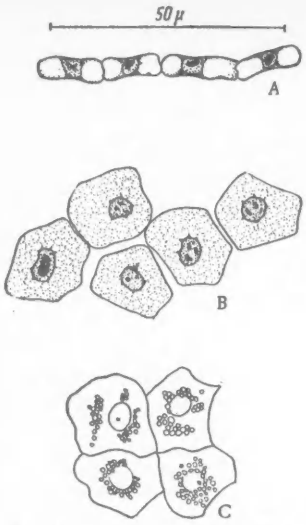


Fig. 9. Serosa cells of late embryo of Angitia vestigialis Ratz. A) in section perpendicular to surface of serosa; B) surface view; C) granules in serosa cells after fixation with Flemming's fluid.

The late Angitia embryo, still entirely covered by the serosa and chorion, is capable of vigorous bending movements together with the membranes investing it. When the membranes have been cast off, the emergent larva manages to grow considerably before the first molt occurs. Thus, A. vestigialis is not included among those ichneumons which retain the egg and embryonic membranes throughout the whole of the first instar.

What happens to the serosa cells after the larva hatches – whether they are eaten by the larva itself, or ingested by the hemocytes of the host, or whether they are merely gradually lysed – I did not manage to discover. I can only note that they disappear rapidly without trace, as distinct from the serosa cells in Dinocampus terminatus Nees (Ogloblin [1924]) and Aphidiidae (Ivanova-Kazas [1956]), which remain alive for a long time in the host's body and are transformed into giant elements.

The fully developed first instar larva of A. vestigialis is outwardly very similar to those of A. fenestralis Holmgr. (Meier [1925]) and A. macrostoma Thoms. (Roberti [1947]) In internal structure, however, it differs from the A. fenestralis larva in the presence of two pairs of Malpighian vessels (and not one), the forking of the ends of the labial glands and the presence of a lumen in the hindgut.

## SUMMARY

A comparison of the development of A. vestigialis with that of other parasitic Hymenoptera reveals that in many respects it retains a primitive character. There is no yolk, but its place is taken by a yolk syncytium filled with a watery fluid, and consequently the spatial relations of the rudiments are the same as in most insects. The embryonic membrane in A. vestigialis does not undergo reduction, as happens in Banchus femoralis Thoms., Prestwichia aquatica Lubb., Caraphractus reductus R.-Kors., and Mestocharis militaris R.-Kors., but at the same time it apparently does not assume a trophic function as in Aphidiidae, Platygasteridae, Encyrtidae and many others. The actual mode of formation of the serosa is more like that of the aculeate, thar. of the parasitic, Hymenoptera. The A. vestigialis larva does not show any significant features of simplification (apart from the absence of limbs and connection between the mid- and hindgut) and as regards level of organization corresponds to larva of the Aculeata. Thus, adaptation to parasitism is manifested in a relatively minor degree in the embroynic development of A. vestigialis, and in general the development of Ichneumonidae retains a fairly primitive character in comparison with other parasitic Hymenoptera. Extreme cases of adaptation to parasitism are not found in the Ichneumonidae.

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# WING VENATION IN LEPIDOPTERA

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Entomologists often reject the presence of a fork on the fore branch of the cubital vein in the wings of Lepidoptera, and regard this fork as the main branches of the cubitus ( $Cu_1$ and $Cu_2$), while its true hind branch they consider as an independent vein, which they call $A_1$. For a long time the same view has been held in regard to the interpretation of these veins in the closely related order – Trichoptera. Although he recognized the incorrectness of this interpretation, Martynov [1934] nevertheless "for convenience" left the terminology as it was [Comstock, 1918]. Entomologists dealing with the systematics of Trichoptera have in recent years started to denote Comstock's first anal vein as CuP or $Cu_2$; these same designations we find in the figures of wings of Lepidoptera in Tillyard [1926] and Weber [1949]. Kozhanchikov [1957], however, in a description of the wing of a Miocene moth of the family Cossidae – Xyleutites miocenicus Kozhantshikov (collection of Paleontological Institute, Academy of Sciences, USSR, No. 254/182, Stavropol') — draws the hind branch of the cubital vein free and calls it $A_1$. The removal of dirt from the impression of the wing of the holotype of this species revealed the existence of a quite distinct, so-called Y-shaped mediocubital (Fig. 1) and that CuA and CuP ($A_1$) both originated from the stem of the cubitus. The Y-shaped figure is usually present in the wings of all the Mecoptera, both fossil and recent; we find a homologous formation in the wings of Trichoptera (very distinct in Rhyacophilidae, Fig. 2b), and also in some Lepidoptera of the family Cossidae (Fig. 3). The Y-shaped figure, in Tillyard's opinion, consists of the free bases of two veins $M_5$ and CuA, which fuse distally into one; only in the ancient Mecoptera of the suborder Protomecoptera and their descendents, the Trichoptera and Lepidoptera, do $M_5$ and CuA diverge again distally, forming the typical fork of the fore branch of the cubitus. The nature of vein $M_5$ is not clear; it may be a cross-vein, or, as Tillyard maintains, it may correspond to the base of the proximal branch of the medial vein. The often observed slanting position of this vein in fossil Mecoptera and its constant presence in the wings of related orders perhaps do confirm Tillyard's view, although we still do not know any fossil Neuroptera or Mecoptera in which $M_5$ is still an independent vein,

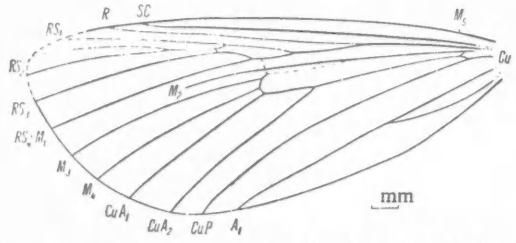


Fig. 1. Xyleutites miocenicus Kozh., fore wing. (Collection of Palaeontological Institute, Academy of Sciences, USSR, 254/182, Stavropol', Miocene).

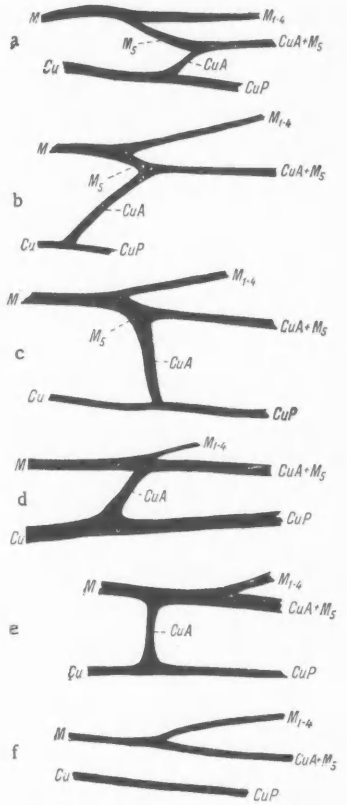


Fig. 2. Y-shaped mediocubital figure in living Trichoptera. a) Glossosoma vernale Pict.; b) Rhyacophila nubila Zett.; c) Phryganea grandis L.; d) Limnophilus microdentatus Mart.; e) Grammotaulius nitidus Mull.; f) Limnophilus despectus Walk.

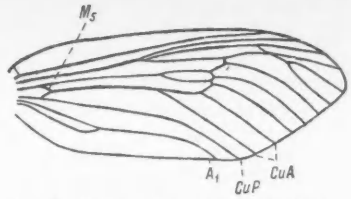


Fig. 3. Xyleutes eucalypti Sc., fore wing of Lepidoptera from present-day Australian fauna.

and not fused with CuA. The existence of a free $M_5$ is possible, if we take into consideration the suggested derivation of Neuroptera from some blattoid ancestors with a many-branched media.

In the wings of present Mecoptera, $M_5$ resembles a cross-vein (Fig. 4), and CuA at the base very clearly arises from the stem of Cu, diverging from CuP. In the Permian Trichoptera the Y-shaped figure is the same as in the Permian Mecoptera. The retention of the bases of CuA and $M_5$ we find also in certain primitive living Trichoptera, but usually in living Trichoptera the base of CuA is like a cross-vein (Fig. 2,e) or is completely reduced (Fig. 2,f); Fig. 2 shows all the stages of fusion of CuA and $M_5$ in Trichoptera from the still entire free bases of these two veins (Fig. 2,a-c) to complete reduction of $M_5$ (Fig. 2,d-e) and CuA (Fig. 2,f). By the Tertiary period, the base of CuA in Limnophilidae resembled a cross-vein, or was quite absent. Thus, CuA appears to branch out from M, and this gave rise to the long-held view that the cubitus and media in Trichoptera were fused at the base of the wing, that the fork of CuA was the fork of Cu, and that the true CuP was $A_1$, although this last concept was contradicted by the concavity of this weak vein, since $A_1$, and CuA are always convex and strong veins in mecopteroids. Since in most Lepidoptera the bases of M and its two main branches have been reduced in the process of evolution (in the formation of the broad discoid cell typical of the order), it is quite understandable that $M_5$ is also absent in these wings; often CuP is completely reduced too; in the Tertiary genus Xyleutites and some present-day Cossidae, however, M is retained completely and there can clearly be seen the common stem of Cu, forking into two main branches, and a short $M_5$.

The change of the radial sector and medial vein has been well traced out in the phylogenitical line Trichoptera – Lepidoptera. In Permian Trichoptera both fore branches of the radial sector had additional forks; by the Mesozoic these additional forks had been lost and the radial sector of Trichoptera had become four-branched. It is of interest that the Miocene moth Xyleutites possesses all four branches of the radial sector and an additional fork on $RS_2$, which indicates the separation of Lepidoptera from Trichoptera which still retained forks of the radial sector, i.e., possibly as early as the Permo-Triassic. In present Lepidoptera the fork on the second branch of the radial sector is lost, while $RS_4$ ($R_5$) is fused with $M_1$.

In Permian Trichoptera M was still six-branched, with additional forks on $M_1$ and $M_2$. Correlated with the narrowing of the wing in the Mesozoic, the caddis flies lost the additional forks of M. In Lepidoptera the number of branches of M was reduced by the Tertiary period, but in a different way from that suggested; the fork of the hind branch of M remained entire ($M_3$ and $M_4$), while the fore branch retained only $M_2$, and $M_1$ fused with the fourth branch of the radial sector ($R_5$).

While there is no need to change the designation of the veins of the radial sector and media in wings of Lepidoptera, CuP must not be regarded as $A_1$; we should accordingly correctly designate the anal veins, of which there are no more than two in Lepidoptera.

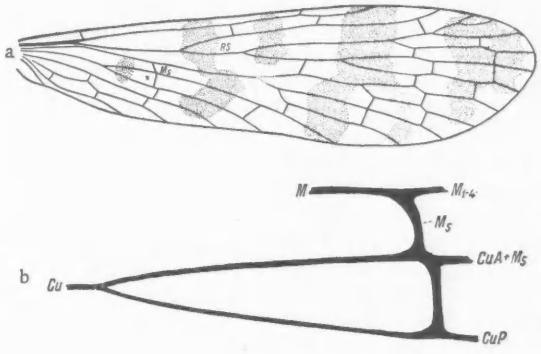


Fig. 4. Fore wing of Mecoptera from the present-day fauna of Eurasia. Y-shaped figure. a) Panorpa communis L., b) Panorpa amurensis McL.

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# ECOLOGY OF SOME LITTLE-KNOWN SPECIES OF HEMIPTERA-HETEROPTERA. I

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Special features of the life of Heteroptera and their food relations have been attracting more and more attention in recent years both in our own country and abroad; at present the main concern of many hemipterological studies is the discovery of the food relations typical of the larval phase of hemipterans, these relations being of decisive importance for the successful development of the population of a species.

As far as can be judged from the information available in the literature the larval food relations recorded for a particular locality are usually typical of the species even at other, often very remote, points of its range. For instance, the injurious shield bug (Eurygaster integriceps Put.) shows a preference for almost the same plants both in Central Asia and in the Ukraine; Psacasta exanthematica Put. in our country and in several countries of Western Europe lives on the same species of Boraginaceae; similar cases are Cydnus aterrimus Först, which is associated with Euphorbia throughout its entire range, Canthophorus dubius Scop., which lives on Thesium (Th. ramosum and other species of the genus), and C. sexmaculatus Ramb., which lives on Ballota ruderalis. The carnivorous species, such as Arma custos F., which specially hunts the alder leaf beetle (Agelastica alni L.), or Eysarcoris punctatus L., which preys on the willow leaf beetle (Lochmaea capreae L.) both in our country and in Sweden, England and other countries, are no exception to the above rule. This rule applies equally to species of other families, for instance, among the coreids Coreus marginatus L., which is everywhere attracted to Rumex and Rheum, or to Leptoceraea viridis Jak., which lives in Tadzhikistan and in the Ukraine only on Acluropus litoralis, and so on; among the lygaeids we can mention Oxycarenus modestus Fall., which everywhere prefers to dwell on alder, Acompus rufipes Wolff. on valerian, Aellopus atratus Goeze on Boraginaceae, and several other species, and of the mirids the alfalfa plant bug (Adelphocoris lineatus Goeze), for instance, which after introduction into the U.S.A. very rapidly became a serious pest of alfalfa there, Hoplomachus thunbergi Fall., which always inhabits Hieracium pilosella, Tinicephalus hortulanus Mey.-D., associated with Helianthemum, and very many other representatives of these and other families of Hemiptera.

The food relations of the imagines and larvae are the same in only a few species; in the former they are usually wider and always completely include the food relations of the latter. Within the families Tingidae, Miridae, and Piesmidae the extension of the food relations in the imagines is relatively slight; in Lygaeidae and Coreidae it becomes very pronounced (Puchkov [1956]).

Usually only a small proportion of the plants which contribute to the extension of the food relations of adult Hemiptera are always used by them or sought out specially, whereas on the others the imagines feed only occasionally, and such plants cannot be considered as the supplementary food plants of the adult stage of the species. However, many investigators in the past and some even at present, confine themselves solely to the adult stage in their accounts of the food relations of species and lump the main and supplementary food plants together, as well as plants used only occasionally by the species (and sometimes not for the purpose of feeding). The number of plants in the last category is always very much greater, and they quite often completely mask the first, so that when we compare the published information on the food relations of adult bugs we often get a completely different picture from that obtained with the larvae. In many cases these relations are extremely diverse, and different authors give a motley assortment of records of a species feeding on various plants, which do not indicate its actual trophic relations. For instance, ever since Grossgeim and Pyatokova [1928] compiled a list of fruit tree pests by simply lumping together everything that occurred on them, some hemipterans, including Adelphicoris seticornis Fieb. (which lives on leguminous herbs) and even Monanthia echii Schrk. (which lives on Boraginaceae) are still recorded as orchard pests. Similarly, such species as Canthophorus bicolor L. (which lives on Lamium, Stachys and other Labiatae) or Liocoris tripustulatus F. (which lives on Urtica) are never associated biologically with fruit trees and bushes—they only land on them by chance from their food plants growing alongside. The same can be said also about Amblytylus albidus Hahn., which lives exclusively on grasses (Corynephorus canescens), but has absolutely no trophic link with Sarothammus growing in the same biotope; nor has Strongylocoris leucocephalus L. any trophic link with either Papilionaceae or grasses (Kirichenko [1951] – this species in the larval and adult stage feeds only on Campanula. Just how far the list of accidental plants obscures the actual trophic links of a species can be seen from the example of Heterogaster artemisia Schill. This species was first associated with Artemisia by Schilling [1829], and later records associated it with Artemisia, Coronilla and grasses (Feiber [1861]), Thymus, Scabiosa (Duda

[1884]), Tanacetum vulgare (Guerin in Butler [1923]), Artemisia, Coronilla, Scabiosa, Sarothamnus, Juniperus (Stichel [1926]), Artemisia (Jones [1928]), Thymus serpyllum (Grossgeim [1930]), Thymus (Schneider [1940]), Artemisia (Bogachev [1941]), Teucrium chamaedrys, T. montanum, Marrubium vulgare, Thymus (Muller [1942]), Corylus avellana, Mentha pulegium, Juniperis communis, Artemisia campestris, Sarothamnus, Coronilla, Scabiosa (Servadei [1951]), Artemisia campestris (Singer [1952]), Thymus (Smreczynski [1954]), Helianthemum chamaecistus, Euphorbia portlandica (Woodroffe [1955]), and grasses (Roshko [1955]). The association of this bug with Artemisia was denied by Butler [1923], and although its actual food plant had been mentioned as early as Duda, and later also by other authors, it remained unnoted among the list of chance plants until recently, when it was shown that it is on thyme (Thymus serpyllum and other closely-related species of the genus) that the population of this species develops in the USSR (Puchkov [1954]) and in England (Thomas [1955] and other). The species is undoubtedly associated with this plant throughout its whole range but it is not impossible that other Labiatae are included among its food plants.

There is no need to extend the list of examples of this type any further. By revealing how far the investigator might err if he relies solely on the food relations of the adult phase, these examples bring out clearly enough the great importance of studies of the ecology of the larval phase of Hemiptera, and such studies have unfortunately not yet received due attention.

The present paper is based on local observations conducted in the neighborhood of the settlements of Ramon' (Voronezh Region) in 1946-1950, Veselyi Podol (Poltava Region) in 1951-1953, and in Kiev, in 1954-1956, and supplemented with expeditionary investigations in other localities of the forest-steppe zone of the European USSR and, in particular, with the material collected in 1954-1958 in the south of the Ukraine; several of the localities studied during the time of the expeditions were visited on several occasions, at different times during the growing period and in different years, and this enabled us to determine the times of development of interesting individual species. In addition, S. I. Medvedev kindly consented to acquaint me with his extensive collections of 1946-1955, which contained larval as well as adult forms of Hemiptera, and which gave interesting information on the distribution and times of development of certain species in the east and south of the Ukraine. From all this material we are able to give a short ecological characterization of some little-known species of Hemiptera, with reference to special features of their life in the larval phase.

Ceratocombus coleoptratus Zett. The small number of localities where this species was found is explained not so much by its rarity, as by its small size and concealed mode of life. In the forest-steppe it was found fairly often, sometimes numbering two to ten specimens per sq dm, in the vicinity of Ramon', the Kamennaya steppe (Voronezh Region), Veselyi Podol, Semenovka, Obolon' (Poltava Region), Goloseevo and Irpen' (Kiev Region). It lives on the soil, among litter and mosses, in shaded, usually humid spots in deciduous and coniferous woods, in parks, and old tree belts. It winters in the egg. The larvae appear in the first half of June, and the young imagines from early July; the larvae can still be found up till early September, and the imagines till early October. In July-August the females lay their eggs, placing them singly in the rotting remains of plants. In has evidently only one generation in the year. Dry weather in early summer suppresses the vital activity of the species, while abundant rainfall in May-June leads to a concerted emergence of larvae, their successful development and a high fecundity of the females. The larvae suck fungal hyphae, the juice of mosses, insect corpses, although in the later larval stages, as in the imago, they also prey on small invertebrates.

Piesma variabilis Fieb. In many localities of Kiev, Poltava and Zaporozhe Regions this species breeds in large numbers on the runners of Herniaria polygama on sands in the glades and on the skirts of tree plantings. It winters in the adult stage among plant detritus and in the upper layer of sand both close to its food plant, as well as at some distance from it, under fallen cones, leaves and other such shelters. In early May, when the warm weather sets in, the overwintered bugs migrate to their breeding sites by flights at a low height. The females start egg-laying in mid-May, and by the end of the first ten days of June the imagines of the new brood become winged, and are found together with the still-ovipositing females of the overwintered generation. The second brood of the species develops in June-July, and the third (facultative in the Ukraine forest-steppe) in July-August. The separate broods considerably overlap one another, and the species can be found at all phases and stages of development throughout the summer.

Galeatus sinuatus H.-S. This species was found fairly frequently in 1947-1953 in many localities of Voronezh and Poltava Regions at the edges of woods, on slopes of ravines, and in fallow lands of several years standing. It bred everywhere on Phlomis tuberosa, and imagines and larvae inhabited this plant in Zaporozhe Region (Vasil'evka, June 25, 1954; environs of Melitopol' and Rodionovka, June, 1954-1956). It winters in the adult phase among plant and moss remains near its food plant. The wakening and renewal of feeding of the overwintered bugs was observed in late April-early May, and egg-laying occurred from the second third of May up till mid-June. The larvae hatch out in late May-June and in large groups, 20-50 specimens in each, settle on the lower surface of the rosette leaves of Ph. tuberosa. A leaf colonized by a group of larvae soon becomes covered with the whitish marks of their feeding tracks, and on the part of the leaf where the main mass of larvae are found the leaf lamina gradually turns brown. The whole colony of larvae leaves the severely damaged, withering leaf and migrates to the nearest fresh leaf. Even on a cursory inspection plants colonized by a mass of bugs

clearly show brownish discoloration where parts of the leaf lamina have died, and totally dead leaves. The separate colonies are always composed of larvae of the same or close stages, thus indicating that a whole mass of eggs was laid by the female at one time and that the larvae hatched out simultaneously from them. The imagines start to acquire their wings by mid-June and by mid-July they are all winged. The feeding of the young imagines does not last long – the bugs retire to their wintering sites at the height of summer, although they do not become inactive till the onset of continuous cold. In a few cases the adult bugs in early spring feed on other plants, particularly on the leaves of species of the genera Lamium, Ballota and Salvia, but we did not observe the development of the larvae on them.

Galeatus spinifrons Fall. This species lives on sands and was found in very large numbers near clumps of Helichrysum arenarium in clearings and at the edges of young pine plantations near the villages of Belyaki and Bovbasivka (Poltava Region) in 1952 and 1953. The bugs kept mainly near very bushy plants with underdeveloped stems; this abnormality in the growth of the plant was due to the numerous injuries inflicted by the bugs on the part of the stem near the root. The species winters in the adult and larval phases among vegetable detritus or in the upper layer of sand near the Helichrysum clumps, or under other plants – Artemisia, Thymus, and grasses. During the winter the population is greatly reduced, mainly through loss of larvae, and in spring the bugs always occur in smaller numbers than in autumn. The overwintered females start egglaying in mid-May, and their egg-laying continues till August (individuals which overwintered as larvae start to lay in mid-summer). The larvae of all stages were found mainly under the leaf rosettes of the Helichrysum, near the bases of the leaf petioles and in the sand around the root neck. They resemble sand in color and are covered with adherent sand grains, so that even when numerous they are not conspicuous. The mass of imagines begin to acquire wings in July, and the adult bugs climb on to the plants more often than the larvae; they fly readily and in the second half of summer are frequently found by sweeping among grass. This species was frequently found also near Helichrysum on sandy long-fallow land in the vicinity of Zaporozhe (June 22, 1954), Kiev (Irpen', May 21, 1954; Koncha-Zaspa, July 9, 1955), Novokhopersk (reserve, June 19, 1958), Ramon' (June 25, 1958), and other places.

Tingis crispata H. S. This species dwells on Artemisia absinthium and A. vulgare on long-fallow lands, on the edges of tree belts, parks, gardens and woods. The females lay eggs in June, depositing them singly, occasionally in small groups, and always at considerable distance from one another (L. V. Puchkova's observations). As distinct from many other Tingidae, the imagines and larvae of T. crispata do not form colonies on their food plants and occur as solitary individuals on them. In July the development of the population is mainly completed. Only the adult bugs overwinter, concealed among plant detritus near the spots where the larvae developed.

Tingis grisea Germ. This species shows a preference for sands and the stony slopes of river terraces, knolls and hills. It lives on Centaurea diffusa, C. besseriana, C. arenaria, C. solstitialis and occasionally on Phaeopappus trinervis. It winters in the adult phase, among vegetable detritus and in the layer of sand under the rosettes of Centaurea and other plants. In the Ukrainian forest-steppe (Poltava and Kiev Regions) egg-laying begins between late May and the first half of June and continues till mid-July. The larvae begin to hatch out in early June and the development of the population is completed by mid-August. The occurrence of this species on plants is also of the solitary type.

Tingis maculata H. S. This species occurs in the east of the Ukraine (Lugansk, Stalino, and Kharkov Regions), and is also recorded from Kursk Region June 11, 1953, Medvedev), the middle Volga, the lower reaches of the Don and the North Caucasus. It is fairly frequent in parts of the Crimea, on the steppes of Tarkhankut and Kerch Peninsulas, as well as on the stony slopes of hillocks in the northern foothills and hills of the south coast. It dwells everywhere on Sideritis comosa, S. montana, Stachys germanica, and St. lanata, on St. recta on the steppes, and has been found very occasionally on Sideritis taurica also. It winters in the adult phase among plant detritus and soon after awakening in spring it gradually migrates on to its growing food plants, and begins to lay eggs in May. The overwintered bugs probably live for a long time, and in the Crimea younger-stage larvae were found from early May to August. The appearance of the first young imagines was recorded in early June in the south. The larvae and imagines, singly or, more often, in small groups, occur among the inflorescences of their food plants, where larvae and imagines of Piocoris erytrocephalus L. actively hunt them. At the end of July, when the food plants begin to winter, the young imagines migrate to a different kind of shelter – under clumps of Teucrium, among lichens, in moss, etc. The number of broods was not established for this species but it is probably only one.

Tingis caucasica Jak. So far this species has been recorded in the Ukraine only from Dnepropetrovsk, Lugansk, Stalino, Kherson, Zaporozhe and Crimea Regions, but it is certainly more widely distributed and probably inhabits the entire south. It lives mainly on Ajuga pseudochia and A. chia, and occasionally occurs on A. genevensis, and A. laxmanni. On the first of these plants many stage I-V larvae and, in smaller numbers, young and overwintered imagines were found on June 15, 1956 in the neighborhood of Andreevka (Dnepropetrovsk Region); in the same locality on August 5, 1956, when almost all the bushes of A. pseudochia had withered, the species had migrated to the rosettes of A. genevensis, where stage III-V larvae and imagines were found, the latter predominating in numbers. In the Crimea T. caucasica is

found fairly frequently on Tarkhankut Pen. (around Olenevka and other places), in the northern foothills (vicinity of Simferopol, Staryi Krym, Glubokyi Yar) and on the south coast (Karadag, Privetnoe, Alsu, etc.).

Monanthia montandoni Horv. Young imagines, pairing individuals, females still ovipositing, and larvae at all stages of development (stages IV and V predominant) were found in very large numbers on Tournefortia sibirica on June 29, 1954; this plant grows in separate clumps on fine shell along the surf zone of the R. Molochnaya liman in the vicinity of Rodionovka (Zaporozhe Region). On a return visit to this biotope in early May 1955, when T. sibirica was just beginning to grow, M. montandoni could no longer be found there, but a few imagines were found among litter under bushes on the slope of the river terrace. S. I. Medvedev also found M. montandoni frequently on this same plant on the shore of the Caspian Sea near the village of Krainovka on June 16, 1954 and at Aleksandriya on the Terek delta on June 18, 1954. Onosma macrochetum is another food plant of this species.

Monanthia rotundata H.-S. This is a common, and frequently an abundant species in several localities of the forest-steppe and steppe zone of the European USSR. In the forest-steppe it inhabits Cynoglossum officinale and Anchusa officinalis on mounds, in glades, on the edges of woods and parks, on the margins of tree belts, on long-fallow lands, and also Echium vulgare on the riverside sands; in the south of the Ukraine (vicinity of Zaporozhe, Melitopol; Genichesk, and Aleshkin sands) it multiplies also on Anchusa gmelini. From observations made in 1951-1953 in the vicinity of V. Podol, overwintered imagines started to feed again in April and by the first decade of May the lower leaves of their food plants were so badly damaged that they withered and died. The females started to lay in mid-May, and in the first third of June, along with pairing and laying imagines, larvae were found in all stages right up to stage V. As the sucked-dry and excrement-soiled lower leaves of the food plants died off the larvae rose higher and higher up the plant, sucking the juices from the newly forming vegetative and reproductive organs. They did not remain in a single large group, like the larvae of Galeatus sinuatus H.-S., but were scattered over the whole plant. Very often even large plants infested by numerous bugs completely died off, and then all the larvae migrated to neighboring plants. In the forest-steppe M. rotundata has no less than two broods in the year. Owing to the protracted period of egg-laying, the generations overlap one another considerably and in the field from June to early August one can find all phases and stages of development of the insect. In August the greater part of the M. rotundata population have become larvae of stages IV-V or imagines; the development of the gonads in the latter is arrested till spring of the following year. By September practically the whole population has changed into adults, and the young bugs gradually migrate to their wintering sites – under vegetable detritus, moss and other such shelters.

While only some species of the genus Tingis live on plants of one family (Labiatae)*, not only the two above-mentioned representatives, but all the species of the genus Monanthia of the fauna of the European USSR, live solely on Boraginaceae. In fact, M. nassata Put. in 1955-1956 multiplied in great numbers on Onosma tauricum throughout the Crimea and by the end of June many plants of this species on Tarkhankut Pen. were so severely damaged that they withered. Imagines in great numbers, and occasionally stage IV-V larvae of M. putoni Mont. colonized Onosma arenarium on Biryuchii I (Zaporozhe Region) on June 19, 1956. M. symphyti Vall. lives everywhere on Symphytum officinale, and in the Crimea on S. tauricum also. M. platyoma breeds on Lappula echinata, and occasionally on Anchusa leptophylla and other Boraginaceae; in the east of the Ukraine, according to S. I. Medvedev, it is fairly numerous on Onosma tinctorium also. M. humuli F. and M. lupuli Fieb. live on Myosotis palustris and closely-related species of this genus, while the widely recorded species M. echii Schrck multiplies on various species of the genera Echium, Cynoglossum, Anchusa and others.

Arocatus melanocephalus F. This is a rather rare species, occurring only in places in Kiev, Poltava, Kharkov, Lugansk, Kherson and Crimea Regions.

Information on its life is rather sparse, and the literature only records that imagines have been found, usually as solitary individuals, but sometimes in groups of some size, under loose bark of trees and in crevices in the wood. By sweeping among bushes (jasmine, Rhamnus, elder) and branches of trees (elm, oak) in a part near V. Podol in 1952-1953 I came across individual stage III-V larvae in July-September, and imagines from May to October. Later, in this and some other localities, wintering bugs were also found in other sites besides those mentioned above – in birds' nests, in pine cones hanging on trees, and in various kinds of buildings, frequently even in houses. Of special interest was the discovery of a large group (more than three hundred) under the loose bark of a half-rotted oak stump in a wooded, but fairly bright and dry ravine near Bokovo-Antratsit (Lugansk Region) on July 10, 1957. At the time they were found, only a few bugs were crawling over the surface of the stump, while the rest, closely packed together, completely covered the wood under the bark. As soon as the bark was removed the bugs scattered and concealed themselves in other shelters. The great majority of the population was represented by adult individuals (all with unripe gonads), and a few stage V larvae. In a further search bugs were found under the bark of a few more stumps but in these cases their numbers did not exceed 30-60 individuals in the group. Not far from these stumps, under an old elm (Ulmus foliacea) growing on the edge of a small clearing numerous larvae of all stages (I to V) and equally numerous adults were found among plant remains

*The labiate Phlomis pungens is inhabited by T. pauperata Put., which occurs in Odessa, Nikolaev, Kherson, Zaporozhe, Stalino, and Lugansk Regions and extends northward to Novokhopersk (reserve).

and masses of seeds which had fallen on the ground. Bugs which were collected there and installed in cages readily sucked the contents of elm seeds, and some females (the overwintered generation) had ripe eggs and laid them among the detritus. On the elm itself, apart from a few individuals caught at the base of the trunk, there was neither an imago nor a larva, since all the seeds had already fallen from the tree. A close association of A. melanocephalus with elm was indicated also by the material of S. I. Medvedev, who collected more than 20 stage III-V larvae and four young imagines on June 15, 1954 by sweeping among elm branches (wood near Starogladkovskaya, Groznyi Region).

Thus, elm seeds constitute the main food for larvae of A. melanocephalus, just as alder seeds are for A. roeseli Schill., and maple seeds for A. longiceps Stal. In the ravine where A. melanocephalus occurred in large numbers a few A. roeseli larvae and large numbers of larvae of all stages and adults of Oxycarenus modestus Fall. were found in ripe alder cones (Alnus glutinosa).

Blissus doriae Ferr. This species is widely distributed in the south of the Ukraine on sandy and sandy-shell soils, often in the immediate proximity of the sea; it extends northwards to Lugansk Region (Aidar). It also inhabits sands in Hungary (Sajo [1897]). The imagines overwinter among tufts of perennial grasses and in plant detritus. From observations made in 1954-1957 in the environs of Radenskii (Kherson Region), on Biryuchii I. (Zaporozhe Region) and Bakal Spit (Crimea), where the species bred in large numbers, egg-laying began in May, assumed a mass character in mid-June and, gradually tailing off, continued till mid-August. The females laid their eggs singly behind the leaf sheaths and among macerated plant remains. The first larvae appeared in mid-June, and from early August young imagines were found along with larvae of all stages. The larvae kept to the bases of the stems, behind the leaf sheaths, and among the dead parts of the plants, and occasionally (older larvae) on the ground itself, among the detritus. The food plants of the species were Agropyrum elongatum, A. macotica, A. dasyanthum, A. repens, Calamagrostis epigeios, C. glauca, and occasionally larvae were found near Atropis distans. Kirichenko [1925] thinks that this species is associated with Artemisia; according to my observations, it uses this plant only as a good shelter, particularly for wintering.

Dimorphopterus spinolai Sign. This species is widely distributed throughout the Ukraine from Transcarpathia and Moldavia (Kishinev) to the eastern border. In the environs of Ramon in 1947-1950 wintering imagines were frequently found among litter and in the upper layer of soil near clumps of Calamagrostis epigeios on sandy soils on the R. Voronezh terrace slopes, which are overgrown with oak groves, and by sweeping through patches of lyme grass (Elymus), cocksfoot (Dactylis) and couch grass (Agropyrum) on sandy soils of plateaus in open old pine woods and on their edges. The bugs began to awake in their wintering sites in mid-April, and in May-June they were also found by sweeping among the grass. In Goloseevo wood the species was found on sandy soil in low ground near the edge of an abandoned road. The bugs occurred among the detritus near clumps of C. epigeios and in the axils of its leaves, one to three bugs in each case. In an inspection on August 13, 1954 only larvae in stages II-V were found; winged bugs began to appear at the end of August, and by early October the whole population had attained the adult phase. The females overwintered with unripe gonads; the formation of ripe eggs in them was noted in the second half of May. Sweeping almost always produced only solitary specimens of fully-winged individuals, but in collections among detritus, on the other hand, the greater part of the population consisted of short-winged forms. A large series of larvae were collected on Elymus by E. M. Tereznikova in Transcarpathia in the vicinity of Berezovo on August 7, 1957 (stages IV and V) and Mukachevo on July 19, 1958 (stages I-IV and egg-laying females).

Dimorphopterus blissoides Baer. This species occurs throughout the south of the European USSR – from the lower reaches of the Danube to the shores of the Caspian Sea. It is biologically associated with the common reed Phragmites communis, where the imagines and a few older-stage larvae overwinter in the axils of the dry leaves and in the hollows of broken stems. In spring, as the young reed shoots grow, the bugs climb on to them, collecting in groups of two to six or more, behind the leaf sheaths of the preapical whorl or among the half-opened apical leaves. There they remain till the end of their life, without moving higher up the stems, which elongate and form new whorls of leaves. Mating, according to observations in the Crimea (vicinity of Sevastopol, Karadag), assumes a mass character from mid-May; by this time overwintered larvae can no longer be found. Soon the females start laying eggs, inserting them behind the leaf sheaths. The number of eggs in a batch varies from one to twenty; their development takes about a month (observation in cages). Intensive egg-laying continues till the end of June; by the end of July (according to observations made in 1956 in the vicinity of Sevastopol) imagines are no longer found, and among the larvae stages II and III predominate. In the second half of August the older-stage larvae predominate, the first young imagines acquire their wings, and this becomes a mass feature in early September (the Crimea, Ivanova-Rybal'che on the lower Don). Larvae at all stages of development cling behind the leaf sheaths of the reed, where they usually form large communities with sometimes as many as a hundred individuals. The young imagines acquiring their wings also remain there. Plants damaged by the bugs differ from healthy plants in their smaller size and the swelling of the whorls colonized by the larvae.

Behind the leaves of various grasses on the shores of the Black and Azov Seas, often on Elymus giganteus, the development of Ischnodemus sabuleti Fall. takes place, at approximately the same time as that of the preceding species. However, the larvae of another species of this genus, I. caspius Jak., according to the material collected by N.

A. Kulikova in the Volga delta, lives behind the leaf sheaths of Typha angustifolia. The females of this species lay their eggs in May, the larvae occur in June and July, and the imagines begin to acquire their wings in mid-July.

Among the species of the subfamily Blissinae in the fauna of the USSR, the subfamily to which the five above-mentioned species belong, there are no crop pests, though they sometimes multiply in mass and greatly suppress the growth of wild grasses. But this family does include well-known pests: Blissus leucopterus Say (the "chinch bug") – a pest of maize in the U.S.A., and Ischnodemus sacchari-vorus Okajiama, a pest of sugar cane in Formosa.

Heterogaster cathariae Geoffr. In several localities of the Ukraine neither this species nor the following one can be classed as rare, though they occur locally. In the regions of the village V. Podol in spring and early summer in 1951-1953 the imagines were found as solitary individuals, though fairly frequently, on Melilotus albus, Urtica urens, Artemisia spp., Verbascum sp., beet transplants, species of Ballota, Lamium, Carduus, Cirsium and on many other, preferably flowering, plants, where they sucked the young shoots and some of the reproductive organs. But all these plants were used more or less by accident; in June the bugs gradually became concentrated on the blossoming catmint (Nepeta catharia), growing on the edges and glades of parks, gardens, near tree belts on mounds, long-fallow lands and on the verges of field paths. Systematic observation and dissection of the bugs showed that the eggs did not begin to form in the oviducts till the second half of July, and their ripening and laying took place at the end of July. In August, egg-laying assumed a mass character and, continuing intensively throughout the whole month, gradually tailed off in September. The larvae began to hatch out in early August. They were found inside the calyces of the catmint flowers and held on so strongly that the younger stages were hardly ever caught by normal sweeping, though they could be obtained by violent beating. Owing to the very late and rather protracted egg-laying, larvae of the younger stages were found until the end of September, while a few stage IV-V larvae were even found in mid-October on withering clumps of catmint and among the plant detritus under them. Most of the overwintered bugs had died off by mid-September, when the young imagines appeared. The latter can be distinguished from the overwintered bugs by another feature besides the state of the gonads – a characteristic reddish hue on the paler parts of the tibiae. This reddish coloration, particularly pronounced in H. affinis H.-S., is peculiar also to other species of the genus. When the imagines became winged they left the catmint, and overwintering bugs could not be found near clumps of this plant. They were found singly under the loose bark of various trees, in cracks in the wood, in pine cones still attached to the trees, in birds' nests, and other such places. Evidently the wintering bugs cannot tolerate dampness and hence seek out very dry spots for wintering.

Heterogaster artemisia Schill. A mass outbreak of this species was noted in 1954 in the environs of Kiev (slopes of Batyevaya Hill, Boyarka, Goloseevo, Irpen'); in numbers of three to ten or more individuals per 1 sq dm, the species occurred under clumps of thyme (Thymus serpyllum, Th. pulegioides, etc.) growing on the clayey slopes of gentle ravines and on sandy glades in open pine woods. In 1950-1958 it occurred on Thymus spp. in smaller numbers in several other localities of the Ukraine forest-steppe and steppe, on mounds, on virgin land, on the slopes of river terraces and stone heaps. Like other species of the genus the larvae of H. artemisia feed mainly on the contents of the unripe and ripening fruits of their food plants. H. artemisia winters in the adult phase in close proximity to its breeding sites – in detritus under clumps of Festuca, Koeleria, or Elymus, in dead cone litter, among the remains of thyme, Artemisia and other plants, where they select drier spots, as is characteristic of Aelia species and many other hemipterans. The bugs awaken shortly after the snow clears and gradually collect on thyme. Ripening of the gonads, pairing, and the laying of the first eggs were recorded in late May (forest-steppe, Ukr. SSR), and the younger-stage larvae were encountered from the second five days of June. In the neighborhood of Kiev in 1954 the mass hatch of the larvae started in the second half of July; in the Crimea it began a week or two earlier. By early August the greater part of the forest-steppe population had passed into the older larval stages, and by the middle of the month they began to acquire their wings. By mid-September almost the whole population had attained the adult phase, and the bugs began to migrate to their wintering sites.

Heterogaster affinis H.-S. This species is distributed in the south of the European USSR, where it is frequently common, and sometimes even numerous, especially in the foothills and parts of the mountain regions of the Crimea and Caucasus . It shows a preference for stony slopes and, being an oligophage, is trophically associated with certain Labiatae, primarily Acinos thymoides. The older-stage larvae also feed eagerly on the seed contents of Clinopodium vulgare, Thymus, and Teucrium. Owing to the fact that the main food plant of the species is an annual with a short growing period, the development of the bug occurs during a more restricted period than is the case with other representatives of this genus in our fauna. The females lay eggs in late May-June, in mid-July the population is mainly represented by stage IV-V larvae (Simferopol neighborhood), and in August there is a mass appearance of young imagines.

The fauna of the Ukraine includes one other species of this genus – H. urticae F., associated exclusively with nettle (Urtica urens and U. dioica). The development of this species takes place at approximately the same times as that of H. artemisia Schill.

Cymophyes ochroleuca Fieb. This species was recorded only from the Lower Volga, the Caucasus, Kazakhstan and Central Asia. On July 1-3, 1954 imagines and larvae of all stages (III-V predominating), numbering three to fifteen individuals per sq dm, were found on the

moist solonets soils of Biryuchii I. (Priazov'e) among plant detritus and clumps of the grass Aeluropus litoralis. Mass mating was observed there, and most of the females contained ripe eggs, as well as ripening ones. This species also occurred fairly frequently on the shore of the R. Molochnaya liman near Rodionovka (June 29, 1954) and on the bank of Dneprovskii liman 20 km below Kherson (June 15-16, 1954), in every case on solonets covered with Aeluropus. In the collections of S. I. Medvedev from the same biotope this species was found in the neighborhood of Vladimirovka (June 6, 1954), Chervlenye Buruny (June 13, 1954), Aleksandriya (June 18, 1954) and Chernyi Rynok (June 20, 1954) (Grozny Region). However, in subsequent years the search for this species in the Ukraine, both in the localities mentioned above and in other similar biotopes, met with no success. Apparently the multiplication of the species in 1954 was due to the exceptionally hot and very dry weather.

Camptotelus lineolatus Schill. In the steppe and forest-steppe zones of the European USSR this species inhabits sandy, clayey and stony spots near thyme. In 1951-1953 this species was found in particularly large numbers, frequently 20-50 individuals per 10 sq dm, at the edge of a pine plantation on sands near the village of Bovbasevka (Khorol District) among tussocks of Thymus serpyllum. In this biotope it was accompanied by larger populations of Pionosomus opacellus Horv., Gonianothus marginepunctatus Wolff and Lasiacantha capucina Germ., which are also associated with thyme. C. lineolatus winters mainly in the adult phase (about 85-98% of the population), but partly as larvae of various stages, which lie bedded in the upper layer of sand and among plant detritus under clumps of thyme and other creeping plants, in tussocks of grasses, under dry cattle-dung, under the bark scales of pines at the base of the trunks, and in other sites. Wakening and feeding of the bugs begin shortly after the snow disappears. The females winter with undeveloped gonads, and the formation of ripe eggs in them was not recorded till late May. The overwintered individuals live for a long time, and the females continue to lay eggs till early August. The egg-laying of individuals which overwinter in the larval phase and change into adults in spring or summer lasts even longer, till mid-September. Owing to the differences in the times of development of the population, larvae and imagines occur throughout the growing period, the larvae predominating from late July till early September, and the imagines in late autumn, spring and in the first half of summer. C. lineolatus undoubtedly has a close food relationship with thyme, and its larvae are not found in plant associations lacking this plant. Nevertheless, in their typical biotopes imagines and larvae of this species often occur under the rosettes of Helicrysum arenarium, Hieracium and other plants, and use them partially for feeding. On thyme the imagines and larvae suck the juices of the vegetative and reproductive organs, and the seed contents, feeding on the last being of particular importance for the successful development of the larvae and females with developing eggs.

Another species of this genus, C. costalis H.-S., was found on sandy fallows among plant detritus in the vicinity of Kiev and in other localities. It winters mainly in the larval phase, and in the rest of its life cycle it resembles the preceding species. It feeds on the seed contents of various plants, including thyme.

Metapoplax origani Kol. In the southern part of the Ukr. SSR and the Precaucasian steppes this species frequently occurs in very large numbers, but it is rare in the forest-steppe zone. The life cycle and the nature of the feeding of this species are the same as those of Oxycarenus collaris Mls. R. (Puchkov [1956]). In the Ukraine its food plants are, primarily, species of the genus Anthemis (A. ruthenica, A. tinctoria), Achillea (A. gerberi, A. euxina, A. glaberrima, A. leptophylla, and occasionally A. millefolium), and also Matricaria chamomilla, Helichrysum arenarium and sometimes Matricaria inodora. In late June and July, 1954-1957 imagines and larvae of this species were found in abundance, dozens on each of these plants, in many localities of the Ukrainian steppe and the mountainous region of the Crimea. Both the imagines and larvae were usually confined to the heads of the plants, but they were not found deep inside the tight inflorescences, as in the case of O. collaris, and at the slightest sign of danger they dropped to the ground and frequently "swarmed" under individual clumps. They occurred on the plants only in the daytime, after the dew had dried up, and during the rest of the day or in rainy weather they remained on the ground among the detritus. An association with Origanum, indicated by the author who first described the species, was not confirmed. In mid-June the females started egg-laying, by the end of July and early August the development of the larvae was completed, and the young imagines migrated to their wintering sites.

Microplax interrupta Fieb. This species is also rare in the forest-steppe, but in places further south it is extremely common and sometimes occurs in mass, although in general it is evidently less numerous and is encountered less frequently then the preceding species, with which it is often found together. It is associated mainly with Achillea glaberrima, A. gerberi, occasionally with other species of this genus, and in places it is frequent on Helichrysum arenarium, but it hardly ever inhabits species of Anthemis, which is specially preferred by M. origani. From mid-June to early August the larvae of M. interrupta are found on the inflorescences of their food plants and under various shelters close to them.

Leptodemus minutus Jak. This species is rare in the Ukraine and was found only on a sandy spit near Bezymyannoe (Stalino Region) where imagines and stage III-V larvae were found singly on sand near Plantago indica.

Oxycaremus collaris Mls. R. In addition to those recorded earlier (Puchkov [1956]) the food plants of this species, which is widely distributed throughout the Ukraine, include Centaurea arenaria, C. diffusa, C. besseriana, C. pseudophrygia, C. sterilis, C. pseudocoreacea, C. ruthenica, C. caparina, as well as Phaeopappus trinervis,

Cirsium incanus, Jurinea laxa, Sonchus and probably several other Compositae with inflorescences forming a compact head which provides the larvae with food and shelter.

Two of our native species of the genus Macroplax, which belongs to the same subfamily Oxycareninae, are associated with plants of the family Cistaceae, the larvae feeding on the seed contents of these. Both species start egg-laying in early June, and this continues till mid-August. Larvae of various stages occur throughout the summer, and the mass of young imagines begin to acquire their wings in the second half of July, although at this time intensive egg-laying is still continuing.

M. preyssleri Fieb. is a more northern species, widely distributed in the forest and forest-steppe zones, where it is trophically associated with Helianthemum nummularium, and occasionally with H. canum; in the south it is numerous on the high hills, in the Crimea (on mountain pasture) on H. italicum and H. glabrum , and in the Caucasus (slopes of Mt. Oshten, Mt. Fisht, around Belorechenskii Pass, etc.).

In the Ukraine M. fasciata H.-S. occurs only in the Crimea, on the northern foothills and the hill slopes of the south coast. It is trophically linked with Helianthemum salicifolium, N. obscurum and other species of this genus, and also with Cistus tauricus, and sometimes adults and larvae are found on Fumana arabica. Larvae, especially the younger stages, are often esconced inside the ripe seed capsules of their food plants, but can also be found among the plant detritus in the ground near them.

Other European species of the subfamily Oxycareninae are undoubtedly oligophagous to some extent in the larval phase and feed on the contents of ripe and ripening seeds of their food plants. This applies also to such ecologically little-known species as Bianchiella sarmatica Kir. and Jakovleffia satulosa Jak., associated with thyme, or Philomyrmex insignis Sahlb. which in Voronezh Region, according to my observations, lives in pine cones hanging on the trees.


## SUMMARY

The trophic links of Heteroptera, which determine the survival of the species, can be ascertained only in their larval phase. Food relations of the species in adult and larval phase coincide completely in a few Heteroptera; in imagines they always include larval trophic links. Having studied the peculiarities of the development of Heteroptera (observations were carried out in 1947-1958 in the Voronezh region and some regions of Ukraine) the author gives in this paper a brief account of locations, cycle of development and food relations of the following species: Piesma variabilis Fieb. (lives on Herniaria polygama), Galeatus sinuatus H.-S. (on Phlomis tuberosa), G. spinifrons Fall. (Helichrysum arenarium), Tingis crispata H.-S. (Artemisia absinthium, A. vulgare), T. grisea Germ. (species of Centaurea), T. pauperata (Phlomis pungens), T. maculata (species of Sideritis, Stachys), T. caucasica Jak. (species of Ajuga), T. montandoni Horv. (Tournefortia sibirica, Onosva macrochetum), Monanthia rotundata H.-S. (species of Anchusa, Cynoglossum, Echium), Arocatus melanocephalus F. (feeds on seeds of Ulmus foliacea), Blissus doriae Ferr. (species of Agropyrum), Dimorphopterus blissoides Baer. (Phragmites communis), Ischnodemus caspicus Jak. (Typha angustifolia), Heterogaster artemisia Schill., associated with Thymus, and species of the subfamilies Oxycareninae feeding upon ripe fruits: Camptotelus lineolatus Schill. (species of Thymus), Metapoplax origani Kol. (species of Anthemis, Achillea, Matricaria), Microplax interrupt Fieb. (species of Achillea, Helichrysum arenarium), Macroplax preyssleri Fieb. (Helianthemum nummularis, H. canum, H. italicum, H. glabrum), M. fasciata H.-S. (Helianthemum salicifolium, H. obscurum and others, as well on Cistus tauricus, Fumana arabica ), Philomyrmex insignis Sahlb. (living in cones of Pinus sylvestris) and some other Heteroptera. All the mentioned trophic links are characteristic of the larval phase.


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# DATA ON THE BIOLOGY OF COCKCHAFERS (COLEOPTERA: SCARABAEIDAE) OF THE PINE FOREST ZONE IN THE ALTAI TERRITORY

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The zone of pine-forest belts lies in the center of districts containing virgin and long-fallow lands in the Altai Territory and in the eastern part of Kazakhstan. This circumstance necessitates the illumination of natural factors which might be significant in agriculture and forestry and also in forest development in these districts. Among these factors belong the insects, and among them, in part, the cockchafers.

During the period of 1930-1950, while working at the Lebyazh'ye Forest Research Station, the author gathered some data on cockchafers which represent a certain interest, especially since this group of insects is insufficiently illuminated in literature for the Altai Territory.

The following species of cockchafers are encountered in the pine-forest belts of the Altai Territory and adjacent districts*:

1) the chestnut chafer (Melolontha hippocastani F.),
2) the June chafer (Amphimallon solstitialis L.),
3) the rusty nocturnal chafer (Serica brunnea L.),
4) the silky nocturnal chafer (Maladera holosericea Scop.),
5) the canine chafer (Lasiopsis canina Zoubk.),
6) the white chafer (Polyphylla alba Pall.),
7) the Siberian green chafer (Rhombonyx holosericeus F.),
8) the small garden chafer (Phyllopertha horticola L.),
9) the eastern leaf chafer (Homaloplia spiraeae Pall.),
10) the crusader (Anisoplia agricola Poda),
11) the striped waxy chafer (Trichius fasciatus L.),
12) the rose chafer (Cetonia aurata L.),
13) the bronze metallic (Potosia metallica Hbst.),
14) the rhinoceros beetle (Oryctes nasicornis L.).

This list obviously does not pretend to be complete and includes only the most widely distributed species, especially in relation to pine forests bordering the steppes.

Of the species listed the chestnut and June chafers are the most serious pests in agriculture and forestry, for which reason we shall dwell on them in somewhat more detail than on the others.

The chestnut chafer was first noted in the Altai Territory by Gebler (Gebler, 1847), who relegated it to the group of common insect species at that time. Later it was noted by Soldatov (1903) as a pest of field crops in the Barnaul District. Subsequently the chestnut chafer is presented in the lists of Rodd (1922) and Parfent'ev (1922), in unpublished reports on pine-forest belts by Radzievskaya (1928) and Rodd (1931); material on the chestnut chafer is contained also in the works of Mesoed and Egorov (1934), Prints (1949), Egorov (1950, 1954, 1958), Shadskii (1951) and Cherepanov (1952); finally, a brief description of the chestnut chafer, applicable to the Altai Territory, is given in a brochure by Isaev and Aleksandrov (1950), treating it as a polyphagous pest of field-crop cultures.

The chestnut chafer in the neighborhood of the Altai Territory of the Novosilirsk Region was studied by Golybinskii (1929), and more thoroughly in the last years by Gol'tsmaier (1951, 1952, 1956). The chestnut chafer is noted in the Omsk Region in the works of Lavrov (1927) and Shvetsova (1952).

Florov (1938) considers that the eastern distribution limits of the chestnut chafer are in Siberia at Lake Baikal; however, Durinov (1951) writes that this chafer is observed also in Transbaikal.

In the pine-forest belts the chestnut chafer is one of the important pests of forest nurseries, causing serious damage to pine cultures, especially in their first years of life; it also damages regeneration pine of natural origin; it also damages, along with other chafers, field-crop and berry cultures on steppe areas arranged near the pine-forest belts.

If the chestnut chafer, along with the June chafer and other chafers generally damages nurseries, arranged mainly at the edge of pine-forest belts, the fact that their damage to forest cultures on barrens within pine forests in various parts of the pine-forest belts is far from similar is explained by differences in the ecological conditions of barrens in the northern, central and southern parts of the zone.

Examinations of soil for infestation by chestnut chafer larvae conducted by the author in various parts of the pine-forest belts exposed the following picture of their settlement in these pine forests.

In the south-western and central parts of the pine-forest belts (from the Srostinsk Forest Reservation and farther south) the chafer prefers to settle under the canopy of thinned plantations, but in open glades they settle predominantly in depressed areas with more fertile and moister soil, and more densely covered with herbaceous vegetation. Broad, dry, pine barrens are infested by the chafer at a very low level, for which reason the chestnut chafer presents practically no danger to the production of forest cultures in such places. This is confirmed by the presence

*Identification determined by M. K. Tikhonravov.

of hundreds of hectares of completely preserved and excellent cultures of pine in many places in barrens in the central and southern parts of the pine-forest belt. The occurrence of places of their wastage in some forest reservations results from other causes, and least of all is this linked with the chafer.

The character of the chafer's settlement in the southern parts of the pine-forest belts coincides with the data of Golovyanko (1951), who writes regarding the Ukraine "the southern pine barrens do not at all appear to be centers of increase for the chestnut chafer".

In the north-eastern parts of the pine-forest belts, under more moderate temperature conditions, the chestnut chafer infests, on the contrary, more open areas, preferring here depressed sections of slightly rolling relief. Although its infestation here in the barrens is generally insignificant (it rarely exceeds 3-4 larvae per sq m), the chestnut chafer together with the June chafer already presents a serious threat to forest cultures on barrens in this part of the zone. For this reason mortality of pine cultures from chafers constitutes a common occurrence; for example, in the Barnaul Reservation in 1939, it attained 70% of the two-year plantings.

Upon the whole it must be stated that infestation of soil by the chestnut chafer in the pine-forest belts is insignificant, and if workers in reservations sometimes express anxiety about the cause of mortality of nurseries or cultures from chafers, then the June chafer is primarily responsible, and shall be discussed below.

In 1949 we encountered very heavy infestations of loamy chernozem soil by the chestnut chafer and other chafers under steppe conditions at one kilometer from a pine forest. A section of raspberries was infested by them in the Sovnarkoma Collective Farm in the RSFSR Egor'evskii District. A patch of raspberries, 0.30 hectares in area, was situated on an elevated place among clumps of birch. At the time of examination (May 16) the raspberries on an area of around half of the patch were already destroyed by the chafer larvae. Excavations, in the raspberries, of three holes, one square meter each, gave the following results concerning infestation in Table 1.

TABLE 1. Infestation of Soil by Chafer Larvae on a Patch of Raspberries under the Conditions of the Altai Steppe

| Hole No. | Chestnut chafer | | | Chafer larvae | | | |
|---|---|---|---|---|---|---|---|
| | larvae | adults | eggs | June chafer | small garden chafer | other | Total |
| 1 | 54 | — | 50 | 7 | 2 | — | 113 |
| 2 | — | — | — | 23 | 2 | 1 | 26 |
| 3 | 86 | 3 | — | 5 | 2 | — | 96 |

Such an exceptionally high infestation is encountered apparently very rarely and only near the forest, since complaints from collective farms of similar damage to gardens have not been submitted to us again for many years. The principal regions of chestnut chafer settlement are always in the pine-forest belts with sandy soil. For this reason it seems difficult to understand the assertion by Prints (1949) that ". . . similarly as in the Western Ukraine, the chafer flies out to the fields, and also in Eastern Altai it flies to the fields for egg-laying". The impression is created that egg-laying does not take place at all in pine-forest belts situated on sands, although somewhat farther on the same author writes: "In the Altai the chafer prefers sandy and lighter soils".

The flight of the chestnut chafer usually begins when the midday air temperature passes 10°C, the temperature at the soil surface reaches +15°, and the temperature at a depth of 40 cm is near +7°. In the central parts of the pine-forest belt this should occur more often toward the last third of April, or more rarely during the first part of May. We present our observation data for the beginning of flight for the chestnut chafer in this part of the pine forests (Lebyazh'ye) for 10 years (Table 2).

In the southern parts of the pine-forest belts the beginning of flight is more often in the middle of April, but in the south-eastern parts (in the Pavlovsk and Barnaul forest reservations) it is in the first third of May. Thus, for example, in 1937 we noted the beginning of flight in the Pavlovsk Forest Reservation (below the Pavlovsk sajene) on May 8, and a mass flight on May 12. Below the Barnaul sajene a mass flight was observed on May 15 in 1934.

The duration of the chafer's flight in the pine-forest belts is equal to about a month, with fluctuations one way or the other, depending on the weather.

On the basis of the relationships of the larval age groups in excavations in different years, a five-year generation was established for the chestnut chafer, which was confirmed by observations of the chafer's flight years. A five-year generation for the Barnaul Reserve was established by Rodd (1931). However, Prints (1949) states that ". . . in the vicinity of Barnaul the chestnut chafer lives four years", but this statement is based not on material from excavations and observations of flight, but on the theoretical deduction of series with the use of sums of effective soil temperatures at a depth of 15 cm.

However, inasmuch as Gol'tsmaier (1951) established a four-year generation even for open places in Novosibirsk, it is possible that under certain conditions there might also be a four-year generation in the pine-forest belts, especially in their southern parts.

Flight years in different parts of the pine-forest belts do not correspond. Thus, when the flight years for the northern parts of the pine forest were 1935, 1945 and 1950, then for the north-eastern parts (Barnaul Reserve), according to the data of E. G. Rodd, they were noted as 1933, 1938 and 1943.

Supplementary feeding of the chestnut chafer occurs principally on birch; more rarely it takes place on aspen and only once was it recorded on yellow acacia.

In view of the fact that the pine-forest belts had undergone fire at different times over their entire areas (close to

TABLE 2. Dates of Chestnut Chafer Flight in the Central Parts of the Pine-Forest Belts

| Years | Beginning of flight | Totals of absol. mid-day air temp | Midday air temp. | Max. air temp. | Mass flight |
|---|---|---|---|---|---|
| 1931 | 30 April | 68.2 | 4.0 | 17.6 | |
| 1932 | 22 " | 122.3 | 10.1 | 21.1 | 27 April |
| 1943 | 25 " | 148.2 | 10.0 | 15.7 | |
| 1944 | 22 " | 163.2 | 15.0 | — | |
| 1945 | 19 " | 95.1 | 17.4 | 25.9 | 29 April |
| 1946 | 1 May | 198.0 | 10.4 | 15.0 | |
| 1947 | 30 April | 244.0 | 13.2 | 19.3 | |
| 1948 | 25 " | 114.6 | 10.6 | — | |
| 1949 | 22 " | 109.4 | 17.2 | 20.7 | |
| 1950 | 2 May | 96.1 | 13.7 | 21.5 | 10 May |

2 million hectares), it naturally could not but be reflected by the character of the settlement of chafers in the soil, particularly the chestnut chafer. It may be presumed from its ecology that fires, in the dry types of pine forests of the southern and central parts, which cleared the soil of trees, favored a decrease in its infestation by larvae of the chafer; in the north-eastern parts of the pine forests, where the chafers prefer open places, on the contrary, favorable conditions are created for the settlement of the chafer in the soil, and which is currently occurring. This question requires special illumination.

Inasmuch as the control of chafers in many instances is conducted in relation to their larval stage, knowledge of the details of larval ecology is of substantial practical significance.

In 1941 and 1942 the author conducted minor investigations of the vertical migration of larvae in two localities in the pineforest belts: 1) in their north-eastern part (below Barnaul) and 2) in the central part of the pine forests (in the Lebyazh'ye Forest Reserve).

In the former instance investigations were adapted to a pine forest-greencherry habitat type (2 test plots in 1941), in the latter – to a dry pine forest habitat type on sloping sand dune mounds (4 tests in 1941, 2 tests in 1942).

Because the chafer larvae do their damage chiefly in fields or openings where silvicultural work is conducted, the test plots were laid out in these situations. The soil was typical pine-forest sands of medium granularity, overgrown with grasses and other herbaceous vegetation.

Work methods included the following: on a test plot after every 5 or 10 days soil excavations were conducted from regular holes of one square meter removing an earth layer every 10 cm and recording larvae by species and age. The excavation period was from April to December. In the summertime the depth of the holes did not exceed 80 cm, but in winter it attained 160 cm. During the excavations temperature measurements were conducted for each 10-centimeter layer of soil and here also samples were taken for soil-moisture determinations.

In these investigations the following data were obtained on the chestnut chafer. In the central parts of the pine-forest belts, in the barrens, the ascent of larvae from hibernation to the surface layer of soil occurs in the course of the last third of April, when the temperature in the lower layers where the larvae wintered (120-140 cm) attains +4° and the temperature in the surface layer (0.20 cm) increases to +8-10°. At this time the average soil moisture for the lower layers is 5%, and attains 6% in the upper layers. Under forest canopies of medium density, where warming of the soil occurs more slowly, the ascent of larvae is delayed for about five days.

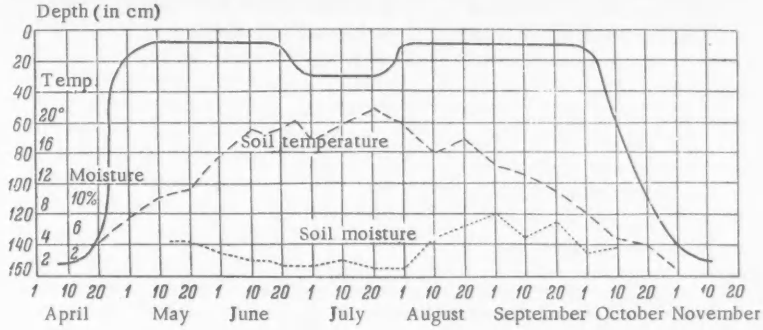
In the north-eastern part of the pine-forest (Barnaul Reserve) in 1941, the ascent of chestnut chafer larvae in barrens occurred in the first third of May, i.e., ten days later than in the central part of the pine forests, however during the same conditions of temperature and soil moisture.

The ascent of the larvae occurs fairly energetically, and, as a rule, in the course of ten days from the beginning of ascent all the larvae have already risen into the surface layer of soil. After the ascent the overwhelming mass of them is found in a layer to 20 cm from the surface. At this time only solitary larvae are taken in the layer 20-30 cm from the surface.

This situation lasts until June 20 in the central parts, and until June 25 in the northern parts. Toward this time the temperature of the surface layer of soil (0-20 cm) attains 20° and higher, and its moisture decreases to 2% and lower. The conditions created by these factors already become unfavorable for the larvae and they descend into the lower-lying layers, however usually not below 30 cm, where the temperature at this time does not exceed 18-20° and the moisture is not below 2%. Thus the combination of temperatures of 20° and higher and moistures of 2% and lower appear as critical times for the larvae, necessitating their descent into lower-lying soil layers.

When the hygrothermal conditions of the upper 20 centimeter layer change in a direction more favorable for the larvae, it is observed that in the central parts of the pine-forest belts toward August 1, and in the northern parts toward July 15-20, the larvae again return to

Curve for Vertical Migration of Chestnut Chafer Larvae (continuous thick line) in the Central Parts of the Pine-Forest Belts.




the surface layer where at this time the temperature is already below 20° and the moisture is above 5%.

It should be noted that the summer descent of larvae occurs more energetically in barrens than under forest canopy where a proportion of the larvae remain in the upper layer during the hot period, which is explained by the moderating influence of the canopy in relation to soil moisture as well as temperature, as instances were observed when the return of larvae into the upper layers occurred even when the moisture in these layers was around 2%, so long as their temperature was below 20°.

After the second ascent into the upper soil layer the chestnut chafer larvae are found here until it is already time to descend for hibernation, which occurs in the central parts of the pine-forest belts at the end of the first third of October, when the temperature of the upper layers (0-20 cm) decreases to 10° and lower, with the soil moisture at 10-12%. The descent of larvae for hibernation likewise occurs fairly energetically, following which the chestnut chafer larvae in barrens are already found in deep soil layers in the last third of October. Under the forest canopy the descent of larvae for hibernation, as compared for the stated interval for the fields, occurs with some delay, not exceeding, however, 5-10 days. In the northern parts of the pine forests the descent of larvae for hibernation occurs several days earlier than the above-stated intervals.

In relation to the influence of relief, it may be stated that in depressed parts, all other conditions being equal, the ascent of larvae from hibernation occurs several days earlier than in elevated parts of the relief. An explanation for this is found in the fact that the elevated parts of the relief are warmed faster in the spring and are cooled more slowly in the autumn.

It was likewise observed that in the spring, in the upper soil layer, the beetles get out earlier than the larvae, and in the autumn they (the beetles) likewise begin to descend somewhat earlier for hibernation.

In literature there is not one opinion regarding the possibility that the imago migrates in the soil. The predominant view appears to be that the beetles hibernate in the pupal chamber (Vorontsov, 1905; Golovyanko, 1909; Uatsentkovskii, 1929; Stark, 1932, and others). However, there is likewise no statement that the hibernation of the beetles does not always occur in the place of their pupation.

Thus, the "Reviews" of the Permanent Commission on Forest Experimental Proceedings for 1914 and 1915 state that in the Buzuluk pine forest there was observed for 15 days a transposition of young hibernating beetles in the soil: females for a distance of 50 cm, and males for 70 cm. Prshemetskii (1909), on the basis of comparisons of the depth of the hibernating adults with the depth of pupal depositions, arrives at the conclusion that ". . .only beetles emerging from pupae lying close to the soil surface move, descending to a great depth . . ." [condensed by us – N.E.].

We judge the possibility of vertical migration in the soil by young beetles on the fact that during excavations we never found pupae in layers deeper than 30-40 cm, whereas beetles were found there at later times: in the northern parts of the pine forests at a depth of 50-60 cm (March 27, 1941, with the temperature of this layer at +1.2°), and in the southern parts even at a depth of 70-80 cm (October 26, 1942, with the temperature of this layer at +13°).

We present the following observations in relation to the depth to which chestnut chafers descend for hibernation in the pine-forest belts: In the central parts in the beginning of November in 1941 and 1942 the larvae were found at a depth of 120-140 cm, where the soil temperature was +12.5-14°, and on April 20, 1942, in addition to finding larvae at the stated depth with the temperature at +0.9°, a proportion of them was found at a depth of 150-160 cm, where the soil temperature at this time was +1.8°.

In north-eastern parts of the pine forests (Barnaul Reserve), during excavations on April 5, when the snow cover was still 80 cm thick, chestnut chafer larvae were found at a depth of 80-90 cm, with the temperature of the soil layer at +1.8°.

Thus, most of the chestnut chafer larvae hibernate in those soil layers where the temperature is maintained at

+0.9 to +1.8°, independent of the depth at which these layers lie.

Gol'tsmaier (1951, 1956) noted that in Novosibirsk chestnut chafer larvae hibernate in a frozen soil layer, with the temperature at -1.5°. We have not observed this in the pine-forest belts, and we doubt that even in Novosibirsk this was of constant and widespread character. Inasmuch as Gol'tsmaier herself noted hibernating larvae at depths up to 120 cm, it is clear that all the larvae strive to leave the frozen layers and consequently, as a rule, cannot remain in them to hibernate. In literature, however, it is stated that at temperatures to -2.5° chestnut chafer larvae become only torpid, onset of their mortality beginning only at temperatures near -4° (Golovyanko, 1951). Thus, Gol'tsmaier's observations of the freezing-in of larvae at a temperature of -1.5 degrees does not disagree with the data on their cold-hardiness in literature; but whether or not this freezing-in is a constant occurrence in Novosibirsk has not been demonstrated for us.

On the basis of the same excavations it has been established that pupation of chafer larvae in the central parts of the pine forests occurs in the period from the beginning of August, generally extending for a month. After August 5 pupae of this chafer are no longer encountered in the soil. Their deposition is most often in a layer 30-40 cm deep, less often in a layer 0-10 or 20-30 cm deep.

At the Barnaul Reserve (north-eastern part) pupae of the chestnut chafer were encountered on July 20 in a layer 20-30 cm deep.

In the central parts of the pine forest eggs of the chestnut chafer were encountered in excavations until June 20, and in the north-eastern parts – until July 10.

The June chafer in Western Siberia was first mentioned by Porchinskii (1907) in reference to the complaints of immigrants of these districts; later this chafer is presented in the works of Rodd (1922) on the insect pests of Altai; Lavrov (1927) mentions it for the vicinity of Omsk; there is information on it for the pine-forest belts in the unpublished accounts of Radzievskaya (1928). For the vicinity of Barnaul the June chafer is listed by Bassel' (1929) as a garden pest.

Material on the June chafer in the pine-forest belts is found in the unpublished accounts of Rodd (1931) and in the works of Mesoed and Erogov (1954). More substantial investigations of this chafer in the steppe parts of the Altai Territory were conducted by Shumakova (1949). The June chafer was marked by Isaev and Aleksandrov (1950) as a pest of field crops. Gol'tsmaier (1951) in work on the chestnut chafer, in reference to the Novosibirsk Region, also presents some data on the June chafer. A brief description of the June chafer for the Kulundinsk Steppe is given in the work of Cherepanov (1952). Finally, Gribanov (1953) presents interesting data on the chafer's nutrition in the imaginal stage.

For Eastern Siberia this chafer is noted in the works of Florov (1938) and Durinov (1951). We personally observed it there near the village of Golumet' in the Irkutsk Region.

In the vicinity of the steppe parts of the Altai Territory the June chafer has an extremely broad distribution. It is encountered in barrens and in dissected stands of the pine-forest belts, as well as on completely open sections of steppe, for example on arable land. Here the favorite places for settlement by the chafer are depressions in forest stands situated in depressed parts of the relief; elevated fields or valleys between them are less heavily populated by them (Srostinsk Forest Reserve, 1934). The number of its larvae on one square meter fluctuates within the range of 2-8 individuals. In the marginal (i.e., bordering the steppes) parts of the pine forest with more compact soils, the density may attain 16 larvae per square meter. Since forest nurseries are largely adapted expressly to marginal parts, the damage from this chafer may be extremely significant here.

Thus the significance of the June chafer as a pest in the pine-forest belts is no less, and in some instances, as in nurseries and cultures, is even greater than the chestnut chafer.

Flight of the June chafer in the central parts of the pine-forest belts begins in the first third of July and lasts until the second third of August. Shumakova (1949) observed in 1929, in the field environs of the Pavlovsk District (the north-eastern part of the pine-forest belt zone), the beginning of flight for this chafer in the last third of July and its end on August 7. In 1937, in this same Pavlovsk District, but in the environs of the sandy pine-forest soil, we found the first beetles in the soil from July 4.

In the 20 years of work in the pine-forest belts we have never observed the feeding of the June chafer in the adult stage. Such feeding has not been observed either by Shumakova, who writes: "Checking into the feeding of the beetle under natural conditions, and also dissections of its intestines, showed that the adult chafer takes absolutely no food". Prints (1948) likewise writes for the Barnaul District: "The beetle does not take extended flights, as it does not require supplementary feeding".

However, Gribanov (1953), in a review of the book by A. I. Cherepanov (1952), writes: "The author describes the June chafer as a pest of the root system of trees and shrubs. However, in the summer of 1952, at the time of a mass-flight of the June chafer, we were obliged to observe very heavy feeding by the chafers on needles of young pines in the Klyuchevsk Forest Nursery Farm. Meanwhile, no explanation is found in the pages of the reviewed book for the described fact".

In correspondence to us on January 20, 1953, L. N. Gribanov adds that ". . . the beetles were so numerous that the young pine needles were eaten to 2/3 of their length along the entire stem".

Thus, in the conditions of the Altai Territory, the June chafer does not feed, as a rule, in the adult stage, but in some years, apparently when the larvae have not fed sufficiently, supplementary feeding may take place.

The June chafer in the Altai Territory has a three-year generation, as established by Shumakova (1949) from

TABLE 3. Age Structure of June Chafer Larvae in the Steppe and in the Pine Forest (Egorevskii District)

| Place No. | Excavation site | Environs | Excavation date | Hole totals | Larvae total by Instar | | |
|---|---|---|---|---|---|---|---|
| | | | | | I | II | III |
| 1 | RSFSR Sovnarkoma Coll. Farm. . . . . | Steppe | May 16, 1949 | 3 | — | 35 | 1 |
| 2 | Srostinsk Forest Res.. | Pine Forest | April 23, 1949 | 10 | — | 1 | 24 |
| 3 | Lebyazh'ye Forest Res. | Pine Forest | April 19, 1949 | 10 | — | — | 56 |

investigations on open (steppe) areas of the Pavlovsk District, with the presence of well-defined flight years. Flight years for steppe conditions were 1926, 1929, and 1932, which was proved by the prevalence of instar III larvae expressly in these years. In 1929, as Shumakova writes, "other instars were almost entirely lacking". Further flight years in the steppe environs, issuing from the three-year generations of the chafer were, consequently, 1935, 1938, 1941, 1944, 1947 and 1950.

Our excavations in the same (1931, 1934) and in following years in the environs of pine-forest belts generally confirm the conclusions of Shumakova on the flight years, but at the same time indicate a significant number of the chafer also in inter-flight years, i.e., a presence of not one, but several broods. Moreover, during simultaneous excavations in a steppe and pine forest at proximally situated points (Egor'evskii District, 1949), it was found that the age structures of the larvae in the environs of the steppe and pine forest diverged (Table 3).

It is evident from this table that in the steppe environs, inasmuch as instar II larvae predominated in the spring of 1949, the flight year followed in 1950, as may have been expected according to Shumakova, whereas in the environs of the pine forest, inasmuch as instar III larvae predominated at the same time, the flight year was 1949. Thus it is obvious that flight years for the June chafer in pine forest environs (on the plains) may be different from that stated by Shumakova. The latter situation suggests that in the pine forest environs the duration of the generations may differ (for example, they may be two-year) from that in steppe environs. Furthermore, there are probably already statements in literature of the existence, in the same district, of two forms of the June chafer. For example, Znoiko (1928) specified for the Odessa Region a form associated with chernozem soil and a form living on the sands. Possibly, something similar takes place in the Altai Territory, and consequently the biology of these forms may have its own peculiarities.

In 1934 we still found large quantities of June chafer eggs on August 15, on the plains in the marginal parts of the pine forest (Lebyazh'ye Reserve). According to Shumakova the time of last discovery of eggs falls on August 21. The following data were obtained in periodic excavations in studies of the vertical migration of June chafer larvae. A mass ascent of this chafer's larvae from hibernation occurred in the central parts of the pine-forest belts from April 25 to May 5, when the temperature of the lower soil layers, where the larvae hibernated, attained +5°, and the temperature of the upper layer (0-20 cm) was found to be in the range of +7 to +12°. Soil moisture for these layers was 4-10% and 7-12% respectively.

In the north-eastern parts of the pine forests in 1941, these conditions occurred in the period from May 5 to 15, i.e., about 10 days later.

An interesting phenomenon is observed in the behavior of the June chafer larvae, as in those instances when an insignificant freeze-up of soil occurs, many of them hibernate in the upper layer, i.e., immediately below its frozen stratum. Thus, for example, in excavations on March 27 in plot No. 1 in the Barnaul Reserve, with a snow cover still 80 cm in thickness and the total freeze-up of soil 2 cm., completely normal instar III June chafer larvae were found in almost each layer, beginning from 0-10 cm and ending at a layer 70-80 cm deep. In excavations on April 5 in plot No. 2 in the same reserve, when the thickness of the snow cover was the same and the freezing of the soil did not exceed 5 cm, the larvae of this chafer were observed in the lower as well as the upper soil layers, the temperature of which fluctuated from +0.5 (0-10 cm layer) to 1.9° (90-100 cm layer).

According to the degree of warming of the lower soil layers to +5° and higher, almost all the June chafer larvae ascend into the upper soil layers – in the northern parts of the pine forests from the surface to a depth of 10 cm, and in the central parts to a depth of 20 cm; only a few of them are found in layers lying below the above mentioned.

In the period of onset of summer heat, i.e., toward the end of June, larvae of the June chafer, and similarly chestnut chafer larvae, likewise descend into lower-lying soil layers, whereupon their descent in the northern parts of the pine forests does not occur deeper than 20 cm from the surface, whereas in the central parts it is observed to a depth of 40 cm. According to the observations of Shumakova (1949) in the steppe environs, the June chafer larvae do not abandon the upper layers in summertime and remain at a depth of 8-9 cm, partly at 8-12 cm, throughout the entire summer; however, this applies only to the north-eastern districts of the Altai Territory (Pavlovskii),

where the larvae in pine forest environs do not descend below the 10-20 cm layer; in the southern district a noticeable descent takes place during the hot period.

Toward August in the central parts of the zone, and toward the middle of July in its northern parts, the larvae of this chafer again ascend into the upper soil layer and are found here until the autumn freeze-up.

Their descent for hibernation in the Lebyazh'ye Reserve was observed in 1941 from September 25, and in 1942 from October 5, in both cases with the onset of temperature in the upper soil layer (0-20 cm) around +10°, and with the moisture of this layer at 3-5%. However, the descent of this chafer's larvae, in contrast to the chestnut chafer, progresses haphazardly so that a proportion is detained in the upper and medium depths of soil layers where they remain to hibernate, a proportion descends to a depth of 100-120 cm in the central parts of the pine forests, and in the northern parts with deep snow cover it descends only to a depth of 90-100 cm. Thus the hibernation of June chafer larvae occurs in all strata of soil, from the lower frost margin to the depth, in this case, of 90-100 cm, with a minimum winter temperature in this layer ranging from +0.5 to +1.9°.

We have not found June chafer larvae in frozen layers of soil, even though it is stated in literature that ". . .they may hibernate in frozen layers . . ." (Berezina, 1952).

Pupae of the June chafer have been noted in the central parts of the pine forests from June 3 to 30, and in the north-eastern parts – from June 25 to 30, mostly in layers to 20 cm and only once (June 30 in the Lebyazh'ye Reserve) at a depth of 20-30 cm, which is evidently related to the increased soil temperature during this period.

Adults of the June chafer were noted in layers 0-10 cm deep in the central parts of the pine forests on July 11, and in the north-eastern parts on July 15.

The rusty nocturnal chafer is generally caught in soil excavations, being encountered, however, chiefly in depressed places in soil with more humus. In part, its larvae are encountered in large numbers in marginal parts of pine forests. For example, in excavations (80 holes) on August 15, 1934, in the margin of the pine forest of the Lebyazh'ye Reserve, we found an average of 5.8 larvae per sq m with a maximum of 40 individuals, and an average of 1.9 pupae with a maximum of 15 individuals.

In excavations (60 holes) of August 18-21, 1934 in the Srostinsk Forest Reserve, likewise in the margin of a pine forest, an average of 4.8 larvae and 1.8 pupae per sq m was encountered, and furthermore, eggs of this chafer were encountered here.

Damage caused by this chafer is generally insignificant because of the small size of its larvae, although they no doubt cause some damage to forest nurseries and cultures.

Flight of the nocturnal chafer is observed here from July to August.

In soil excavations in 1941 and 1942 adults of this chafer were encountered in the upper soil layers(0-30 cm): in the Barnaul Reserve on July 15, and on the Lebyazh'ye Reserve from June 20 to July 10 and from August 21 to October 20.

Pupae of the nocturnal chafer were found in the Lebyazh'ye Reserve from June 10 to 25 and also on September 1, likewise in a layer 0-30 cm deep. These data indicate that the chafer apparently may overwinter, as well as its larvae.

Thus its flight period is not well defined seasonally; the duration of its generation remains obscure for us.

The canine chafer is likewise widely distributed in the steppe parts of the territory, being encountered in the open steppes as well as in the pine-forest belts. It was observed by us mostly in the Lebyazh'ye Forest Reserve, but Shumakova observed it in the field environs of the Pavlovsk District.

Flight of the beetles was observed by us in daylight hours during bright sunshine, and in the afternoon, which differs from the statement of Medvedev (1951), who writes of this chafer: "Flight occurs in the eveningtime; in the daytime the beetles hide in the soil, under stones and other shelters"

Flight of the canine chafer occurs from the end of June to the middle of July, mass flights in the Lebyazh'ye Reserve being observed in the end of June and the beginning of July.

This chafer has no noticeable economic significance here, which agrees with the statements of Il'inskii (1948).

The white chafer was first found here, at the Lebyazh'ye Station, in 1930 (Mesoed and Egorov, 1934), settling in the central and south-western parts of the pine-forest belts, chiefly in the marginal areas. It is not observed in the north-eastern parts of the pine forests (Barnaul, Rebrikhinsk forest reservations). However, the north-eastern border of its range, represented by Medvedev (1951:103) as being in the vicinity of the Ob' Irtysh inter-river land space, should be moved somewhat farther from the Irtysh toward the Ob' to a distance about half-way between these rivers.

Density of its larval populations may be illustrated with the data gathered in 1933 in the Lebyazh'ye Forest Reserve and presented in Table 4.

As can be seen, the white chafer prefers to settle in barrens of dry pine forests, and in these conditions it replaces the chestnut chafer, and may play a noticeable role in damaging cultures.

In the central parts of the pine forests it flies at the beginning of July, at dusk.

Kamenskii (1949) notes the flight of this chafer in the Naurzumsk pine forest from June 20 to July 7.

The Siberian green chafer likewise is widely distributed in the pine-forest belts of the Altai Territory, preferring to settle in level and slightly depressed places with comparatively rich soil.

In the central parts of the pine forests its flight occurs at the end of June, but in Barnaul – at the beginning of July. We have repeatedly observed it engaged in supplementary feeding on pine needles, which is also noted by Prints (1949) and Medvedev (1952).

TABLE 4. Population Levels of White Chafer Larvae in Soil

Dry pine forest

| Forest type | Hole totals | Larvae totals by instar | | | | Per 1 m² |
|---|---|---|---|---|---|---|
| | | I | II | III | total | |
| Dry pine forest | | | | | | |
| a) cut plantation | 36 | 5 | 4 | — | 9 | 0.8 |
| b) plains | 21 | — | 9 | 4 | 13 | 0.6 |
| Grassy pine forest | | | | | | |
| a) plantation with density of 0.5-0.6 | 15 | — | — | — | — | — |
| b) plains | 12 | — | 1 | 1 | 2 | 0.2 |

In the Barnaul Reserve in 1941, we encountered its pupae from June 5 through 20 in a layer 0-20 cm deep, and the formed beetles – on June 20 in a layer 0-10 cm deep.

In the central parts of the pine-forest belts the ascent of the chafer larvae from hibernation occurs in the end of April-beginning of May, and in the north-eastern parts it occurs in the beginning of May. After the ascent the overwhelming proportion of them is found in a layer 0-20 cm, and even 0-10 cm deep. In the central parts, with the onset of summer heat (end of June), descent of larvae was observed into a 20-30 cm layer, where they were found until the end of July, after which they again ascended into the upper soil layers. Descent of the chafer larvae for hibernation occurs at the end of September with the temperature of the upper layer around +10° and its moisture around 4%. Hibernation in most of the larvae occurs at a depth of 80-100 cm, but in the central parts of the pine forests larvae were encountered to a depth of 100-110 cm, and in the north-eastern parts (April 5, 1941) larvae were observed in a stratum from 5 to 60 cm, which is explained by a lesser freeze-up of soil here in a given year.

This chafer apparently has a one-year generation, with which Prints (1949) also complies.

We note here, that during the excavations, larvae were encountered, judging from the arrangement of spines on the posterior part of the anal sternite, belonging to the genus Anomala, but we were unable to determine them more exactly. Only a supposition may be expressed that these were larvae of A. errans F.

The small garden chafer, appearing in the soil in depressed areas, often being confused with other chafers, however, has not been noted to cause damage to the root systems of forest species. But during supplementary feeding the beetles may cause noticeable damage to fruit cultures especially apple, on which heavy defoliation by these chafers may sometimes be seen.

Its flight in the central parts of the pine forests occurs from the middle of May to the middle of June, and in Barnaul, somewhat later.

The larvae, and likewise the pupae and beetles of the small garden chafer, in the course of the entire period of our excavations in 1941 (from the end of March to the middle of August) in the Barnaul Reserve, were encountered at a depth to 20 cm and very rarely in a layer 20-30 cm deep. On April 5, with a snow cover of 80 cm, these larvae were found under the frozen crust of soil in a layer 0-10 cm deep, together with June chafer larvae. In excavations on November 16, 1942 in the Lebyazh'ye Reserve, when there was still no snow cover, and the soil was frozen to a depth of 30-32 cm, larvae of the small garden chafer were found in the frozen soil layer.

In the Barnaul Reserve in 1941 its pupae were encountered from May 25 in a layer 0-20 cm deep. Consequently, its flight occurs later here than is stated for the Lebyazh'ye Reserve.

The eastern leaf chafer noticeably damaged 3-4 year-old birches in the wind-break strips of the Egor'evskii District. The beetle itself causes the damage during supplementary feeding, perforating the leaves and thoroughly thinning the crown of the birches. In addition to birch, it likewise damages the leaves of plum and, rarely, ash-leafed maple and poplar. In 1944 a mass flight of this chafer was noted on June 29.

Rose chafers. The more frequently encountered rose chafer (Cetonia aurata L.), in the blossoming period of yellow acacia, service berry, apple, and other species, is encountered in masses on these species, eating the flowers. It is often caught also on the flowers of unbelliferous plants. Its larvae are occasionally encountered almost exclusively in depressed areas with soil rich in humus. Sometimes Potosia metallica Hbst. is also encountered on flowers together with Cetonia.

The rhinoceros beetle is encountered in the central parts of the pine-forest belts; but it is more often noticed in the Klyuchevsk Forest Reservation, bordering Kazakhstan.

As regards the rest of the chafers presented in the list (the silky nocturnal chafer, the crusader and the striped waxy chafer), we have no observations other than their presence among the fauna of the pine-forest belts.

## SUMMARY

The following account presents data on Scarabaeidae of the pine forests zone, situated among the steppes between the Ob' and Irtysh rivers (51-54° N. lat., 79-84 E. long. from Greenwich.

The most injurious of the 14 species of beetles described herein are the following: Melolontha hippocastani F., Amphimallon solstitialis L. and Polyphylla alba Pall. Their larvae are injurious to the roots of pine cultures and seedlings of forest reservations; Amphimallon solstitialis L., besides, is injurious to steppe conditions. Emergence of Melolontha hippocastani F. begins when the mean daily air temperature exceeds 10°, the soil surface temperature exceeds 15°, and the soil temperature at a depth of 40 cm exceeds 7°. In the Egor'evskii Region (the central part of the pine forests) this period begins at the end of April. The beetles feed on birch. The ascent of larvae from hibernation (at a depth of 120-160 cm) begins when the temperature of these layers reaches 4° and the soil moisture reaches 5%. They remain in the 0-20 cm layer to the end of June. When the temperature of this layer reaches 20° and the moisture decreases to 2%, the larvae descend to 30 cm and remain there until August; after this period they again ascend into the upper soil layers. The hibernation period begins when the temperature of the upper layers falls to 10°. Hibernation occurs at a depth of 120-140 cm or even at 150-160 cm, where the winter temperature is within the limits of 0.9-1.8°. Pupation takes place in July at a depth of 30-40 cm. They have a five-year generation.

Amphimallon solstitialis L. fly from the beginning of July to the beginning of August. They do not feed as a rule, but in certain years they may feed on needles of young pines. The larvae begin to leave the hibernation sites when the temperature attains 5°; this takes place at the end of April or at the beginning of May. Then they stay in the 0.20 cm layer, going deeper during the hot period. Descent for hibernation occurs when the temperature of the upper soil layers drops to 10°. Hibernation usually takes place at a depth where the temperature is maintained within the limits of 0.5-1.9°. Pupation occurs throughout June at a depth of 20 cm. They have a three-year generation with a well-defined emergence, which, however, does not coincide in pine forest and steppe environs.

Polyphylla alba Pall. is distributed only in the southwestern part of the described zone. The beetles fly only in the beginning of July in the twilight and dwell in open places with dry sandy soil.

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# AN EXPERIMENTAL INVESTIGATION OF THE ECOLOGICAL FACTORS INDUCING IMAGINAL DIAPAUSE IN BLOODSUCKING MOSQUITOES (DIPTERA, CULICIDAE)

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The problem of the ecological regulation of seasonal development cycles in insects has attracted many research workers. Of all the various environmental factors, the length of daylight seems to be the most constant and reliable indicator of the onset of conditions unfavorable for further development of the insect. However, the experimental demonstration of the importance of the daylight factor as a regulator of seasonal periodicity is a comparatively recent development (Danilevskii, 1956; Dickson, 1949; Way and Hopkins, 1950; Lees, 1955). The photoperiodic reaction as an adaptation to seasonal change has arisen independently in many insects, but only in certain groups has it been studied with any degree of completeness. The most detailed and extensive investigations in this field have been carried out on Lepidoptera. Comparable studies on mosquitoes are very few in number.

The possibility of stimulating activity in bloodsucking mosquitoes Culex pipiens while they were overwintering by subjecting them to twenty-four hours of illumination per day, has been noted by Tate and Vincent (1932, 1936).

It has been shown experimentally that subjecting larvae of Anopheles barberi Coq. and Culicoides guttipennis Coq. undergoing diapause to long-day illumination, caused them to resume their activity (Baker, 1935).

The duration of diapause in Anopheles bifurcatus L. larvae has been shown to depend on the light regime (Khodukin and Lisova, 1953). It has also been demonstrated that in Aedes triseriatus (Say) larvae, the decrease in hours of daylight during the autumn induces the onset of diapause (Love and Whelchel, 1955).

The onset of imaginal diapause and the extent to which it is correlated with the processes of digestion and maturation of the gonads in Anopheles maculipennis messeae Fall, and Culex pipiens pipiens L. has similarly been shown to be dependent on changes in the length of daylight (Danilevskii, Glinyanaya, 1958).

The photoperiodic reaction, as an adaptation to the presence of seasonal changes in the environment, ensures the synchronization of the insectan life cycle with those same changes, such that diapause is induced in the most resistant stages of development at a time just before conditions become most unfavorable.

The aim of our investigations was to elucidate the peculiarities of the photoperiodic reaction in different species of bloodsucking mosquitoes and relate our findings to the various distributional ranges and biological requirements of those species; also to determine the differences in the photoperiodic index of single species and relate these to their areas of distribution. With this aim in view, the following species were selected for investigation: (Anopheles maculipennis messeae Fall., A. mac. atroparvus Thiel, A. hyrcanus Pall., A. superpictus Grassi, A. pulcherrimus Theob., Culex pipiens pipiens L., C. pipiens molestus Forsk.). The species enumerated differ in their respective geographical areas of distribution. Thus, according to Markovich, A. mac. messeae is confined to temperate latitudes with a continental type of climate and its southern limit of distribution is limited by high winter temperatures, whereas its very close relation, A. mac. atroparvus, is a form of temperate latitudes with a warm Atlantic type of climate (Beklemishev, Shipitsina, 1957). A. superpictus and A. hyrcanus are more southerly species and the latter is usually subdivided into a large number of intraspecific localized forms, which occur not only in temperate latitudes but also in the tropics, according to Horsfall (1955). The species under investigation differ also in their physiological adaptations to overwintering; all the species are characterized by an imaginal diapause, during which there is a cessation of sexual activity but nevertheless certain forms may continue to take an occasional blood meal (A. mac. atroparvus, A. superpictus), whereas in other forms feeding has not been observed during this period (A. mac. messeae, A. hyrcanus). Thus the biological characteristics of the experimental species present a very varied picture.

Practically all mosquitoes throughout the USSR undergo a winter diapause as imagos; for comparative purposes, however, other species (A. pulcherrimus which have a larval diapause were included among those chosen to investigate their photoperiodic reaction. Furthermore, in order to elucidate the ecological characteristics of different geographical races within a single, widely distributed species, A. mac. messeae and A. hyrcanus were selected.

## Methods

The whole development cycle from egg to imago was carried out under controlled conditions of light and temperature. When the experiments were conducted in

thermostatically regulated chambers, the variation in temperature did not exceed ± 0.5°, while the variation in the laboratory temperature was ± 1.5°. The light regime was automatically controlled in some instances and the experimental material, being subjected to warmth, was placed by hand in a light-proof packet. The source of light employed was a 40-watt electric lamp; in some cases it was necessary to combine natural daylight and artificial illumination to obtain the appropriate light regime.

In the majority of cases, except A. mac. atroparvus and C. p. molestus, egg clusters were obtained from wild females. The larvae were raised in enamel vessels, in which water containing plants (Elodea, filamentous algae) had been placed. During the period of larval development, the water was changed several times. Young larvae were fed on emulsions of Daphnia, older larvae on dried Daphnia. The pupae were transferred to different vessels where they remained until the imagos emerged. The latter were kept in gauze cages of dimensions 35 × 20 × 20 cm. In certain cases, in order to increase the humidity of the cages, they were covered with wet cloths. The first day after emerging from the pupae, the males were fed on solutions of sugar or glucose, after which they received only water. Beginning with the 2nd, 3rd, 4th or 5th days after emerging (depending on the species) the mosquitoes were given a daily meal of blood which lasted 30-40 mins. Anopheles spp. were given human blood, Culex spp. preferred that of chicks. After having been fed, female mosquitoes were transferred to different tubes and kept there until their meal of blood was completely digested, when they were dissected. Only fully gorged females were taken into account in the experiments, as failure of the eggs to develop is the normal consequence of an uncomplete meal of blood (Lentinova, 1953). Repeated feeding was required in the case of certain species. The extent to which the fat body and the gonads were developed after digestion of the blood meal was used as the main criterion for determining the physiological condition of the females.

The fat body was evaluated in three stages: I – females thin, fat body in the form of nodules, II – females somewhat fatter, lobed fat body, III – females stout, lobes of fat body numerous.

The development phases of the gonads were evaluated according to the generally used system developed by Christophers.

As is well known, active females are characterized by their gonotrophic harmony; i.e., the digestion of one portion of blood leads to the maturation of a portion of the eggs. In females undergoing diapause, such a parallelism between digestion and maturation of the eggs is broken and the development of the ovary is retarded. Thus, in experiments with mosquitoes in diapause, after digestion of the blood meal, the eggs had not developed further than Christophers stage II. Most of the experimental mosquitoes had not been impregnated, for with the exception of A. mac. atroparvus and C. p. molestus, the species used did not readily mate in a confined space. Long (1956) has placed on record the fact that certain mosquitoes, e.g. Aëdes aëgypti, show a retardation of the development of eggs when the females have not been impregnated but have been allowed to suck blood. This may possibly explain the failure of the certain experimental mosquitoes to ripen their eggs even under optimum light conditions and in the absence of diapause.

The data obtained from these experiments is of considerable interest for comparison with the phenology of the species under investigation.

The peculiarities of the photoperiod reaction in mosquitoes is most conveniently described by considering different species separately, for not all of them have been studied to the same extent. The most detailed studies have been made on A. mac. messeae.

## THE PHOTOPERIODIC REACTION OF MOSQUITOES

### Anopheles maculipennis messeae Fall.

The experiments to be described were carried out in the Entomological laboratory of the Leningrad State University at Staryi Petergrof (Latitude 60°) and at the Astrakhan National Park (Latitude 46°)—the two places representing the northern and southern portions of the distributional range of this species.

The whole life cycle of this species was followed through under different light regimes but at a constant temperature of 22° - 24°. The different conditions of illumination had no effect on the duration of larval development or on the bloodsucking activities of the females which under laboratory conditions were usually slight; the various light regimes had, however, a marked effect on the physiological changes which determine the onset of imaginal diapause.

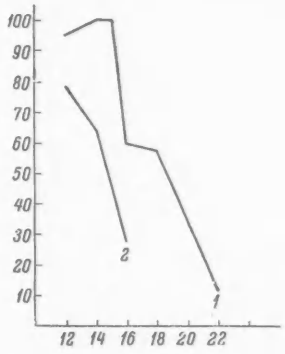


Fig. 1. Relationship between onset of diapause in Anopheles maculipennis messeae Fall. and light conditions. 1) Leningrad form (Lat. 60°); 2) Astrakhan form (Lat. 46°) Abscissal axis — day-length in hrs. Ordinate axis — no. of individuals (as %).

The dependence of the onset of diapause, in the northern form of malarial mosquito, on light conditions operating during its period of development, is shown in Fig. 1, curve 1. As the length of day decreases, the number of females undergoing diapause increases proportionately. Long-day conditions (22 hrs) induce diapause in only 10.8% of the mosquitoes, whereas short-day conditions (15 hrs light or less) induce diapause in all the mosquitoes (100%). The transition from development without diapause to 100% diapause takes place gradually as the daylight decreases from 22 - 15 hrs per day. Such a long transitionary element of the curve distinguishes mosquitoes from other insects, where even trivial changes in the duration of light (less than one hour) may bring about a complete inversion of the type of development.

Other criteria of the physiological condition of females, e.g., the extent to which the fat body is developed, have been observed to show a similar dependence on the light regime (Vinogradova, 1958). The number of individuals in the first stage of fat body development, characteristic of active females, decreases from 97.3% under long-day conditions (22 hrs) to 32.5% under short-day conditions (14 hrs) whereas the number of females in the third stage of fat body development which is characteristic of females during diapause shows a corresponding gradual increase. A similar relationship between fat body development and light conditions has been noticed for A. mac sacharovi Favre by Khodukin and Lisova (1954).

As is well known, length of day varies according to latitude; consequently, we might suppose that the response to changing day length would be different in distinct geographical forms of the same species. This is indeed the case, as may be seen by comparing the photoperiodic response curves for the Leningrad and Astrakhan populations of A. mac. messeae (Fig. 1, curves 1 and 2). The photoperiodic index in the southern form is considerably lower than in northern form; for example, for the Astrakhan form, a 16-hr daylight regime is a long day and induces only a 27% diapause, whereas for the Leningrad form under the same conditions the number of individuals which undergo diapause is much higher (59.5%). A similar picture is shown in the case of a 14-hr daylight regime.

The phases most susceptible to changes in photoperiodic conditions are the third and fourth instar larvae and successive development stages. This can be detected from special experiments on the change of light regime on the process of development in the Leningrad form of A. mac. messeae against a constant temperature background of 22-23°C. The schemes and results are set out in Table 1.

When short-day larvae, commencing at the third instar, are transferred to conditions of long-day illumination (Expt. 1), the imaginal diapause does not take place; the reverse change in light regime, however (Expt. 2) induces diapause in all females. When the same reversal of light regime is delayed until the fourth instar (Expts. 3 and 4), the reaction of the females is less definite. A similar picture occurs in the case of females from the Astrakhan population of A. mac. messeae. Larvae were captured in the field between the 16th and 21st of May at the end of their instar of developments, and were subjected to different light regimes; the results of the experiments are given in Table 2. Larvae transferred to long-day conditions of illumination (15 and 16 hrs) produced comparatively few adults undergoing diapause, whereas those which were transferred to short-day conditions (12 hrs) gave many more adults which underwent diapause (50%). Thus it would appear that in A. mac. messeae the onset of imaginal diapause is produced under the influence of short-day illumination and the developmental stages most susceptible to these conditions are the older larvae and subsequent phases.

TABLE 1 Results of Experiments Designed to Determine the Developmental Phases most Susceptible to Changes in the Photoperiodic Reaction for Anopheles maculipennis messeae (Leningrad).

| Expt. No. | Light cond. in diff. phases of dev. | | | | | | No. females dissected after feeding | % in diapause |
|---|---|---|---|---|---|---|---|---|
| | larva | | | | pupa | imago | | |
| | I | II | III | IV | | | | |
| 1 | ——— | ——— | ——— | ..... | ..... | ..... | 8 | 0 |
| 2 | ..... | ..... | ——— | ——— | ——— | ——— | 4 | 100 |
| 3 | ——— | ——— | ——— | ..... | ..... | ..... | 11 | 27.2 |
| 4 | ..... | ..... | ..... | ——— | ——— | ——— | 14 | 57.1 |

Note: ——— short day; ..... long day.

## Anopheles Maculipennis Atroparvus Thiel

A culture of A. mac. atroparvus was subjected to a study of its photoperiodic reaction in order to compare the latter with that of A. mac. messeae; the culture of the former subspecies came from Odessa (latitude 46°). It was noticed that under laboratory conditions a negligible number of active females developed mature eggs after a single blood meal (similar observations have been made by other research workers) and therefore the physiological condition of the experimental females was determined both after one blood meal and also after they had partaken of two meals of blood. The results of these experiments are set out in Table 3.

The bloodsucking activities of the experimental females were sufficiently high to be regarded as independent of the light regime; the ripeness of the females however, was found to be clearly dependent on the latter. The number of "unripe" females increased as the day length decreased. However this number was high even under long-day conditions (16, 18 hrs). This failure of eggs to ripen in certain mosquitoes may be due to the adverse genetical factors which manifest themselves in varying degrees in different species.

The photoperiodic reaction of this southern population of A. mac. atroparvus exhibits a certain sensitivity to temperature changes. Thus, at a temperature of 18°, even under long-day conditions (20 hrs), 69% of the population underwent diapause, i.e., a considerably greater number than in the same light conditions at 25°.

## Anopheles hyrcanus Pall.

The characteristics of the photoperiodic reaction in A. hyrcanus have been studied at two distinct geographical points: in the Astrakhan national park, a region which lies just within the northern limit of distribution for the species (Poryadin, 1941) and in the national park in the valley of the R. Vaksha in Southern Tadzhikistan (latitude 37°), which lies in the middle of the area of distribution for the species. The number of females dissected after feeding on blood, for each light regime, varied from 30 to 85. The results of four experiments show that differences in day length have no effect on the duration of development among the females, but the onset of imaginal diapause is controlled completely by the light regime during development (Fig. 2).

This described reaction on the part of the Astrakhan race of A. hyrcanus is represented by a photoperiodic curve of a somewhat attenuated character (Curve 1). Because of the southerly distribution of the species under consideration, the first individuals to undergo diapause, do so at a considerably shorter day-length than occurs in the case of A. mac. messeae. At 18 hr, 16 hr, and 15 hr illumination, diapause is absent, and only when 14 hr day-length is reached do individuals undergo diapause to any extent; the

TABLE 2 Results of Experiments Designed to Determine the Developmental Phases most Susceptible to Changes in the Photoperiodic Reaction. Anopheles maculipennis messeae (Astrakhan).

| Light exposure (in hrs) | Mean temperature (in °C) | Mean development time (in days) | No. females dissected after feeding | No. of females in diapause | |
|---|---|---|---|---|---|
| | | | | No. | % |
| 16 | 19.5 | 11.5 | 19 | 1 | 5.2 |
| 15 | 21.1 | 14.8 | 36 | 2 | 5.4 |
| 14 | 21.2 | 13.3 | 14 | 1 | 7 |
| 12 | 20.0 | 15.4 | 32 | 16 | 50 |

TABLE 3 Relationship between Ripeness of Female Anopheles maculipennis atroparvus and Light Conditions during Development

| Light exposure (in hrs) | Mean developmental temp. (°C) | Mean developmental time (in days) | After 1 blood-meal | | After 2 blood-meals | |
|---|---|---|---|---|---|---|
| | | | No. females dissected | % unripe | No. females dissected | % unripe |
| 20 | 25 | 15.3 | 35 | 17.1 | — | — |
| 18 | 25 | 21.9 | — | — | 32 | 59.3 |
| 16 | 25 | 21.3 | 14 | 71.4 | 19 | 84.2 |
| 12 | 25 | 20.6 | 17 | 100 | 14 | 78.5 |
| 10 | 25 | 25.9 | 6 | 66.6 | 10 | 70 |
| 20 | 18 | 25.6 | — | — | 32 | 69.5 |
| 12 | 18 | 24.8 | 11 | 90.9 | — | — |

number of individuals undergoing diapause increases with decreasing hours of illumination. However, even under typical short-day conditions (12 hrs), by no means all individuals undergo diapause. Whether this latter phenomenon is related to the relatively high temperature (23°C) at which the experiments were carried out or to the absence of a complete occurrence of diapause in this species is difficult to say.

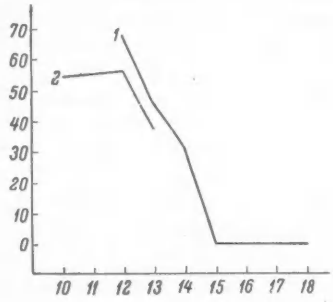


Fig. 2. Photoperiodic reaction of Anopheles hyrcanus Pall. 1) Astrakhan form (Lat. 46°), 2) Tadzhikistan form. (Lat. 37°). Rest of designations as in Fig. 1.

The second series of experiments (Curve 2) were carried out at a latitude 9° farther south (Tigrovii ravine), yet they did not reveal any significant difference in the photoperiodic index of the two geographical populations. The explanation of this fact may be found in comparing the seasonal changes of natural illumination at the two points under consideration. The difference in day length between Astrakhan and the Tigrovii ravine during the period of diapause onset in females under natural conditions, is very small; for example on August 1st it is 46 min and on August 30th 26 min, whilst by the end of September the difference has completely disappeared.

Despite the fact that the temperature during the second series of experiments was 27°, i.e., 4° higher than during the first series, the percentage of flies undergoing diapause was very little less, although usually a higher temperature decreases the tendency toward diapause under short-day conditions (Lees, 1955). This fact testifies to the extremely powerful influence of photoperiodicity in determining the onset of diapause in this species. Among other peculiarities of A. hyrcanus, we may mention the relationship between the agressiveness of the mosquitoes and light conditions during development. The "long-day" females display a greater degree of bloodsucking activity than do the "short-day" females which undergo diapause. A similar state of affairs has been observed in nature. A sharp drop in the number of A. hyrcanus attacking human beings occurs during August and September in the Astrakhan reserve (Bagirov, 1953).

## Anopheles superpictus Grassi

An investigation of the photoperiodic conditions determining the physiological state of A. superpictus females was carried out at Stalinabad (Latitude 38°). The results are set out in Table 4. The different conditions of illumination have no effect on the length of the developmental period. The extreme uniformity in length of larval development under laboratory conditions and the 100% survival of the larvae is worthy of note. The various light regimes have no effect on the bloodsucking activities of this species; this is obviously related to the lack of any need for repeated bloodsucking during the winter, despite the complete cessation of sexual activity (Luppova, 1954; Il'yashenko, 1956; Gugushvili, 1957).

Determination of the physiological condition of the females was accomplished by carrying out dissections after a single blood meal and after the mosquitoes had consumed two blood meals. The need for a repetition of feeding as indicated in the literature is confirmed by our finding that by no means all the females are ripe after one blood meal (c.f. Kanchaveli, 1955; Gygushvili, 1957). From Table 4, it may be seen that under short-day conditions, (10, 11, 12 or 13 hrs) the females do not become ripe after one blood meal. Similar results are obtained even after the females have fed twice. When the day length during development is increased to 15 hrs, the percentage of unripe females only falls to 66.6%. Thus the effect of short day illumination in the case of this species is absolute, and brings about a disturbance of the normal relationship between feeding and ripeness of the gonads. There is a rather high percentage of unripe females, even

TABLE 4 Relationship between Ripeness of A. superpictus Females and Light Conditions during Development

| Light exposure (in hrs) | Mean devel. temp. (°C) | Mean devel. time (in days) | After 1 blood-meal | | After 2 blood-meals | |
|---|---|---|---|---|---|---|
| | | | No. females dissected | % unripe | No. females dissected | % unripe |
| 15 | 18.6 | 23 | — | — | 18 | 66.6 |
| 13 | 19.2 | 24 | 11 | 100 | 11 | 100 |
| 12 | 20.5 | 22.2 | 12 | 91.5 | — | — |
| 11 | 19.2 | 24 | 12 | 100 | 25 | 92 |
| 10 | 18.9 | 22 | 24 | 100 | — | — |

after long-day conditions, which at this latitude corresponds to a 15 hr period of illumination; this is possibly due to the fact that laboratory conditions have an adverse effect on the maturation of the ovaries, as is the case in A. mac. atroparvus.

Anopheles pulcherrimus Theob.

The experimental work on A. pulcherrimus was carried out in the Tigrovii Valley Reserve. The literature indicates that this species overwinters as a larva (Vasil'ev 1913; Kazantsev, 1932) so we decided to study the effect of different temperatures and light conditions on the course of larval development. To this end we carried out daily counts of larvae in different instars and also counts of newly metamorphosed pupae.. In each experiment the initial numbers of larvae lay between 150 and 600 individuals. The effect of different photoperiodic conditions was studied against three temperature backgrounds; 27°, 25.8° and 18.4°. The different light regimes did not affect the rate of development of the various instars either at 27° or at 25.8°. Fig. 3 shows the progress of larval development typical of the higher of these two temperatures.

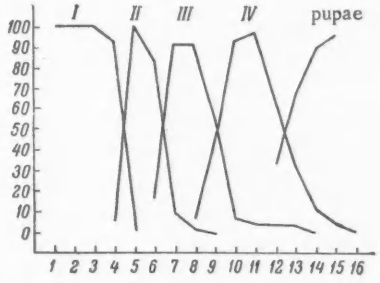


Fig. 3. Development of Anopheles pulcherrimus larvae at 14 hr illumination and a temperature of 27.6°C. Along abscissa – days taken for development; I - IV – larval instars. Along ordinate – no. of individuals (as %).

It may be seen that the transition from one larval instar to another is distinct and rapid, as indicated by the similar form of the curves; the duration of development for the various instars is not long. A rather different picture emerges when the effect of short-day illumination is combined with that of the lower temperature (Fig 4); here the picture shows a considerable retardation of development, which is very clearly expressed by the marked attenuation of the third instar period The larval ecdysis at the end of the first instar and that between instar II and III occur at approximately the same time throughout the whole population, the duration of the first and second instars not exceeding 7 and 8 days respectively. Larvae in their third and fourth instars begin by keeping more or less together in their development; of the IVth instar larvae, 95.7% (91 larvae) molt during the first 9 days of development (from the 15th to the 24th), whereas only 4.2% show a retardation of ecdysis and molt during the subsequent 15 days (24th to 39th). Some of the larvae (13.6%) did not undergo any ecdysis at all after the second and remained as IIIrd instar larvae until the end of the experiment. It is to be regretted that the experiment was terminated after 39 days and the ultimate fate of these larvae is not therefore available. We may summarize by saying that the development of A. pulcherrimus under short-day conditions (10-12 hrs) and at a low temperature (18°) is characterized by a certain portion of the larvae exhibiting a tendency toward retarded development and this may represent the vestige of larval diapause which is reported to occur under natural conditions.

The relationship between the physiological state of the female and the light factor is shown in Table 5.

Bloodsucking activity among the females of this species is identical under all light treatments. When development takes place at temperatures of 27° or 25.8° under short-day conditions, an insignificant percentage of the females (3.4 - 4.2%) show unripeness; this percentage increases (9.5 - 11.1%) somewhat when the experimental temperature is decreased to 18.4°. The failure of the females to attain complete maturation of the ovary is a characteristic sympton of diapause: the gonads are found to have reached Christophers phase III and the fat body lobes are well developed.

This experimental production of imaginal diapause in A. pulcherrimus is interesting, although its biological significance is very difficult to assess in the absence of any phenological data for this species. Certain authors have indeed noticed a dearth of mature A. pulcherrimus during cold conditions (Vasil'ev, 1913; Khodukin and Shterngol'd, 1937). At the same time, there is a report in the literature

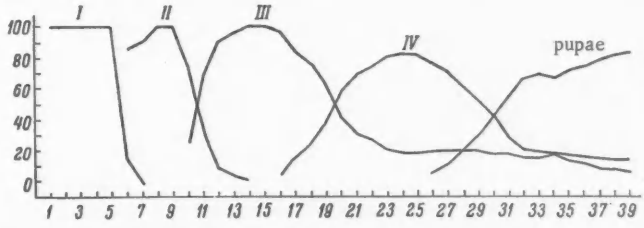


Fig. 4. Development of A. pulcherrimus larvae under a 10 hr illumination regime at a temperature of 18.4°. Captions as for Fig. 3.

TABLE 5 Relationship between Physiological Condition of Female A. pulcherrimus and Conditions of Illumination and Temperature during Development.

| | Day length (in hrs) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 10 | 12 | 13 | 14 | 15 | 10 | 12 | 10 | 12 |
| | Mean devel. temp. (°C) | | | | | | | | |
| | 27.1 | 27.2 | 27.6 | 27.6 | 27.6 | 25.8 | 25.8 | 18.4 | 18.4 |
| Mean devel. time (days) | 13.6 | 16.8 | 14.9 | 14.5 | 13.7 | 16.7 | 16.1 | 33.2 | 32.7 |
| No. females dissected after feeding | 71 | 75 | 59 | 47 | 42 | 69 | 66 | 21 | 18 |
| No. showing diapause — No. | 3 | 3 | 2 | 2 | 0 | 4 | 4 | 2 | 2 |
| No. showing diapause — % | 4.2 | 4.0 | 3.4 | 4.2 | 0 | 5.8 | 6.1 | 9.5 | 11.1 |

(Trofimov, 1941) of the finding in Azerbaidzhan during November, of several females belonging to this species which showed all the symptoms of diapause (ovaries in Christophers phase I - II) and well developed fat bodies.

## Culex pipiens pipiens L. and Culex pipiens molestus Forsk.

Two forms (C. p. pipiens and C. p. molestus) of the polytypic species C. pipiens are of considerable interest to the research worker, for despite their very slight morphological distinction, they show marked biological differences.

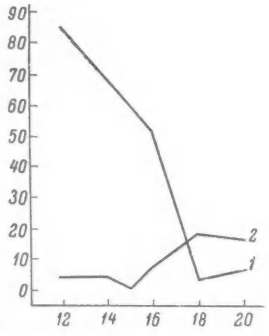


Fig. 5. Dependence of diapause and blood-sucking activity in Culex pipiens pipiens L. on light conditions during development. 1) diapause; 2) blood-sucking activity i.e., mean percentage of females undergoing a single feeding. Abscissa – day-length in hrs; ordinate – no. of individuals (as %).

Whereas C. p. molestus has the ability to mate in a confined space and can lay its first batch of eggs without feeding on blood, so that in a temperate climate it has become an obligate human commensal with the ability to reproduce all the year round, C. p. pipiens lacks these characteristics. In the latter form the imaginal diapause is clearly expressed whereas in C. p. molestus it is absent; it is therefore of considerable interest to compare the photoperiodic reaction of these two subspecies. The results of this investigation are set out in Fig. 5, which shows both a diapause curve and one for bloodsucking activity. In C. p. pipiens there is a clear dependence of bloodsucking activity on light conditions during development. Agressiveness among females is very low under all light conditions; however, it is significantly higher in the case of those reared under long-day conditions as compared with those under short-day conditions. The onset of diapause in this subspecies is determined by the light factor. From the figure it is obvious that under long-day conditions (18-20 hrs) the number of females undergoing diapause is negligible (3-6%), whereas under short-day conditions (12 hrs), the number is quite large (85.7%).

By contrast, in female C. p. molestus, the gonads mature normally under favorable conditions quite independently of any particular light regime during development; of the females which were dissected, 30 had developed under long-day conditions and 45 under short-day conditions and in all cases the gonads were ripe.

This characteristic of C. p. molestus has been previously noted in the literature (Tate and Vincent, 1932, 1936; Jobling, 1937, and others).

## Comparative Analysis of Experimental and Phenological Data

As can clearly be seen from an analysis of the experimental results, the light factor is the main regulatory mechanism for determining the onset of diapause among imagos of bloodsucking mosquitoes. In contrast to other insect species, bloodsucking mosquitos show a very great individual variation in their reaction to the photoperiodically effective day length and this results in a considerable attenuation of the photoperiodic curve. This feature of the photoperiodic reaction among mosquitoes is fully in accord with the manner of occurrence of diapause among female

mosquitoes in the field. As a rule, the onset of diapause under natural conditions is slow and the time of appearance of the first individuals undergoing diapause to the complete diapause of the population at large may be as long as 15-30 days. Each species shows its own peculiar response to photoperiodic conditions in addition to the general response just mentioned; moreover, the critical day-length is not only different for different species but varies within a single species according to the geographical origin of the population concerned. Any experimental determination of the photoperiodic index for a given species should be considered in relation to the possibility of the characteristic being an adaptation to particular natural conditions. Unfortunately phenological data are not available for the majority of species which were investigated experimentally; exceptions are A. mac. messeae and A. superpictus. Even when both experimental and phenological data are available it is difficult to establish the degree of correlation between them because of our lack of precise data regarding the threshold of light-intensity perception among insects and particularly among mosquitoes. Usually, and this is true of the data set out in Table 6, the duration of natural daylight is taken to include the half-light of both dawn and sunset, but there is the possibility that such illumination is not perceptible to insects and the day-length is therefore correspondingly diminished.

The most favorable subject for comparing experimental and phenological data is undoubtedly A. mac. messeae. In view of its considerable epidermological significance, the phenology of this species has been studied over a wide geographical range (Beklimishev, Shipitsina, 1957). As a result of many years of phenological observations, the mean periods for the onset of diapause have been determined in different parts of the USSR. Table 6 shows the characteristic photoperiodic reaction of A. mac. messeae according to phenological data (Shipitsina, 1957).

Columns 1 and 3 give the day-length at the times when diapause occurs in the females. However, bearing in mind the fact that the physiological condition of the females is determined by the light regime operating during larval life, it is more appropriate to consider the data given in columns 2 and 4, which relates to the period 10 days (Astrakhan) and 15 days (Leningrad) before the onset of natural diapause in the female, i.e., the time which corresponds with the middle of larval development.

The experiments show that at a day length of 22 hrs, 10.8% of the Leningrad A. mac. messeae individuals undergo diapause (see Fig. 1, curve 1); this agrees fairly well with the figure for duration of daylight in nature during the time of larval development (Table 6, column 2). In Astrakhan A. mac. messeae (see Fig. 1, curve 2), 22.7% of the individuals undergo diapause when the day-length is 16 hrs; this figure is almost the same as that for the duration of daylight in nature which brings about diapause (Table 6, column 2). There is a greater discrepancy, however, between the experimental results and the phenological data given in column 4 of Table 6. This creates the impression that in the field, diapause is induced by a comparatively greater day-length than in the experiments. The light factor always goes hand in hand with the temperature in determining diapause, and the latter may alter the light threshold, either raising it or lowering it (Goryshin, 1955). The discrepancies between the experimental and phenological data may, therefore, be due to the effect of temperature. The mean temperature operating throughout the experiments was higher than that which occurs in nature; this applies particularly in the case of the Leningrad population. Moreover, the temperature background throughout the laboratory experiments was much more constant than would occur in the field where both diurnal and seasonal variation in temperature occur. This cannot but have some effect on the photoperiodic reaction in the two cases.

It is very interesting to note that recognition of the photoperiodic reaction as a regulator of the seasonal cycle of development in A. mac. messeae might well be deduced purely from the phenological data in the wealth of material collected by Shipitsina in 1957; moreover this data is in complete agreement with the facts obtained by the experimental method. The following features are shown by both phenological and experimental results: The variation in critical day-length for a given species according to the latitude from which it is derived; the difference in photo-

TABLE 6 Photoperiodic Conditions Determining the Onset of Diapause in A. mac. messeae in Nature

| Localities | Duration of daylight | | | |
|---|---|---|---|---|
| | when female diapause first appears | middle of development in larvae corresp. to females | onset of mass diapause in females | middle of development of corresp. larvae |
| | 1 | 2 | 3 | 4 |
| Leningrad Lat. 60° | 19 hr 44min July 24 | 21 hr 20min | 18 hr 10min August 8 | 19 hr 44 min |
| Astrakhan Lat. 46° | 16 hr 08min July 29 | 16 hr 32min | 14 hr 26min August 27 | 15 hr 11 min |

periodic indices between two subspecies from the same locality; the effect of temperature upon the illumination threshold, etc.

A. superpictus is another species for which phenological data is available (Luppova, 1954) and we can therefore compare the former data with that obtained experimentally. In agreement with our own observations is the fact that in the vicinity of Stalinabad, 30.8% of the females of this species go into hibernation during the first 10 day period of September, 63.5% of the female population is in hibernation by the third 10 day period of September and by the end of October only a few active mosquitoes are to be found. Our experimental results show that in 1958 all the mosquitoes of this species which emerged at the end of September passed into a state of diapause. Moreover, , females raised from larvae collected in the field between September 19--23 did not become mature even after several blood meals. That the newly emerged females of the autumnal generation of A. superpictus go directly into hibernation in most cases, has been shown for Turkmen by Melnikova (1943); for central Tadzhikistan by Il'yashenko (1956) and for the Western Pamirs by Zanina (1957). The larvae of the autumnal generation, which may give females undergoing diapause, begin their development during the second half of August or in September at a day-length of $14^1/_2$ hrs or less. This day-length is sufficiently near to the photoperiodic index of experimental females in which the process of feeding and maturation of the ovaries were interrupted by diapause; at a day-length of less than 14 hrs the females did not mature.

Hence in both the cases which we have described (i.e., A. mac. messeae and A. superpictus), there is a considerable agreement between the photoperiodic conditions inducing imaginal diapause both in the experiments and in the field.

## SUMMARY

The photoperiodic reaction of bloodsucking mosquitoes with imaginal diapause has been studied. The mosquitoes were reared from egg to imaginal stage under definite temperature and different conditions of illumination. In experiments, diapausing females were considered to be those individuals in which ovaries never developed beyond the phase II (Mer and Christophers) after the digestion of one blood meal.

1. The seasonal changes of physiological state of females in Anopheles maculipennis messeae Fall, Anopheles maculipennis atroparvus Thiel, Anopheles hyrcanus Pall., Anopheles superpictus Grassi, Culex pipiens pipiens L. are determined by the illumination during their development. If the mosquitoes are exposed to a short day-length they enter diapause, if to a long day-length they develop without diapause.

2. The critical photoperiod inducing diapause differs considerably in different species of mosquitoes. For instance, all the females of A. mac. messeae (Leningrad, 60° N. Lat.) enter diapause with a photoperiod of 15 hrs, but all the females of A. hyrcanus (Astrachan, 46° N. Lat.) preserve the reproductive activity under similar conditions of illumination.

3. The critical photoperiod inducing the gonotrophic dissociation and imaginal diapause in different populations of the same species decreases from the north toward the south within its area of distribution.

4. Both investigated races of C. pipiens differ in their reaction on the photoperiod. In heterodynamic C. pipiens pipiens the photoperiodic reaction is pronounced, while in homogynamic C. pipiens molestus Forsk. it is not.

5. The physiological state of females is determined by the day-length during the old larval stages and the phases following development.

6. In some species studied (A. hyrcanus, C. pipiens pipiens) the biting activity as a criterion of physiological state of females depends on the illumination during their development; in other species studied (A. mac. messeae, A. mac. atroparvus, A. superpictus) that dependence does not exist.

7. Experimentally determined critical day-length allows us to explain the rate of change in the incidence of diapause of mosquitoes species in nature.

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# ON THE BIOLOGY AND ECOLOGY OF Microchryza polita L. (DIPTERA, STRATIOMYIIDAE)

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Translated from Entomologicheskoe Obozrenie Vol. 39, No. 2, pp. 341-348, April-June, 1960

In a report on the Diptera of the Leningrad Region, Shtakel'berg [1954] described Michrochryza polita L. as a widespread and abundant species in the region; however, no additional information regarding its biology or ecology is given in the literature. The author carried out a study of flies of importance to man, in the town of Ivanov, and during the course of this study he made several series of observations on this particular species. Some of the observations provide the basis of this present paper.

The research was accomplished with the aid of various techniques: the capture of winged forms in traps set in open country; the smearing of leaves, fruit and berries with sticky material in order to catch the flies; the setting of net-traps baited with fish, kvass (a fermented drink) or feces; the capture of flies indoors by hand, using small tubes; the placing of "control-tents" for the capturing of flies in their breeding places, the taking of liter samples in various biotopes, in order to investigate the numbers of pre-imaginal stages, after identifying them together with associated species; and also the carrying out of investigations on the substrate with respect to its composition, humidity and pH (i.e., techniques similar to the methods used previously by the author, see Lobanov, 1958).

The winged forms of M. polita are usually to be found on the outskirts of towns on vegetation of various kinds. With the aid of sticky mucilages, we were able to trap them on black-currant bushes and apple trees; we observed the activities of the flies on the leaves of apple, black-currant, cherry, plum and certain other plants, including, occasionally, grasses.

The first imagos appear during the second half of May; they attain their greatest abundance between the end of June and the end of July; during August they become rare. Full-grown larvae make their appearance by the end of July (July 27th in 1958) and are to be found among rotting clumps of vegetable refuse. We have not been able to discover any mass autumnal flight of flies, nor any increase in their numbers during August and September. In our experimental breeding of this species, only a few males emerged at the end of August. We conclude, therefore, that M. polita is a monocyclic species.

We carried out trapping of flies in net-traps on the edge of the town during the course of three seasons. Over this period, in each of the three traps, from 55 to 161.4 thousand flies, belonging to various species, were captured; but not a single M. polita was found among them. Moreover, M. polita was never taken in the few traps set in woodland or in rural areas.

We recovered M. polita from traps set in windows of human dwellings during the summer months from June to

TABLE 1 The Larval and Pupal Population of M. polita from Various Biotopes

| Biotopes | No. biotopes investigated | Samples taken | No. samples yielding fly larvae and pupae | No. samples yielding M. polita larvae |
|---|---|---|---|---|
| Drain pits | 12 | 28 | 26 | — |
| Cesspools | 6 | 26 | 21 | — |
| Lumps of feces | 2 | 3 | 3 | — |
| Horse manure (lumps) | 8 | 20 | 14 | — |
| Horse manure (stacked) | 4 | 6 | 1 | — |
| Cow manure (lumps) | 5 | 5 | 4 | — |
| Cow manure (stacked) | 1 | 1 | 1 | — |
| Pig manure (lumps) | 8 | 10 | 10 | 1 |
| Pig manure (stacked) | 1 | 1 | — | — |
| Calf manure (lumps) | 1 | 1 | 1 | — |
| Hen manure | 2 | 2 | 2 | — |
| Scrap-heaps | 2 | 3 | 2 | — |
| Dust from under floors | 2 | 5 | 3 | — |
| Dust bins | 1 | 1 | — | — |
| Rotting vegetation | 6 | 10 | 7 | 4 |
| Silos | 1 | 1 | 1 | — |
| Garden soil | 10 | 10 | 10 | — |
| Bark of aspen stump | 2 | 2 | 2 | — |
| Totals | 74 | 135 | 108 | 5 |

August. A total of 57 traps were set in urban surroundings and these yielded 1202 flies, of which 14 individuals (1.15%) belonged to the species under consideration.

In order to study the locality and conditions of overwintering for the pre-imaginal stages, we took 135 liter samples from 74 biotopes, belonging to 18 different types [Table 1]. From Table 1 it may be seen that M. polita larvae inhabit biotopes where vegetation is undergoing decomposition. One positive result was obtained from a lump of pig manure, in which larvae were found, but closer examination revealed that the pig manure was surrounded by rotting plant material from which the larvae could have migrated. Migration of larvae belonging to this species has been observed more than once in the laboratory: On adding excess water to the substrate in which larvae were being reared, they migrated on to the walls of the vessel; moreover, immediately prior to pupation the larvae usually crawl on to the surface of the substrate or on to the walls of the containing vessels. At the end of September, M. polita larvae were found in mulch (sawdust) under apple trees, but at a distance of only one meter from a clump of grass.

Experiments on the emergence of flies after overwintering were carried out using "tent-nets" in different biotopes. The results of our observations are set out in Table 2. They confirm the data obtained from the liter-sample experiments.

The setting up of "tent-nets" enabled us to determine the time of imaginal emergence from hibernation [Table 3]. From the data in this table it is fairly obvious that the period of emergence is relatively late and is a protracted one.

According to our observations, the pre-imaginal stages of several other species of flies overwinter in clumps of rotting vegetation together with M. polita [see Table 4]. However, the number of larvae belonging to the latter species usually exceed that of any other species in the same habitat, often attaining 431 examples per liter sample.

The results obtained from the "tent-nets" also testify to the high population densities of M. polita larvae in their particular habitats. In a "tent-net" placed over a drain pit, in 1955, a total of 1358 flies were captured; of these 467 individuals, representing 34.4% of the total, were M. polita. A "tent-net" placed over a pile of rotting plant material in 1956 yielded 85 fly individuals, of which 84 were M. polita.

The amount of organic material in the substrate, the humidity and the pH of the medium appear to have a direct or possibly indirect influence on the population density of M. polita larvae in a given biotope. We took 12 samples in all, from biotopes which were associated with decaying plant remains. Biotopes which yielded positive sampling results were found to have an organic content varying from 9.55 to 22.1%, a humidity of 41.01 to 58.66%

TABLE 2 Emergence of Flies and Their Capture in a "Tent-Net" Placed over Winter Quarters of Larvae

| Biotopes | No. nets placed in position | No. nets yielding flies | No. nets yielding M. polita |
|---|---|---|---|
| Drain pits | 3 | 3 | 1 |
| Soil around cesspools | 2 | 1 | — |
| Horse dung | 1 | 1 | — |
| Soil in places where horse dung occurred in autumn | 1 | — | — |
| Pig manure | 1 | — | — |
| Plant compost | 1 | 1 | 1 |
| Totals | 9 | 6 | 2 |

Note: The drain pit from which M. polita emerged was one used during the summer period of the previous year but which had since been discarded and filled up with vegetable refuse, grass cuttings etc., i.e., the pit was a habitat of the type characteristic for M. polita, containing rotting grass.

TABLE 3 Time of Emergence of M. polita from Its Winter Quarters

| | Months in 10-day periods | | | | | | | At a later date |
|---|---|---|---|---|---|---|---|---|
| | May | June | | | July | | | |
| | III | I | II | III | I | II | III | |
| 1955 | 1 | 5 | 83 | 179 | 143 | 43 | 5 | 0 |
| 1956 | — | 9 | 42 | 31 | 2 | 0 | 0 | 0 |

TABLE 4 Characteristic Samples, Taken at the Winter Quarters of Microchryza polita Larvae

| No. samples | Date sample was taken | Biotope | Characteristics of substrate | | | Fly larvae and pupae observed | |
|---|---|---|---|---|---|---|---|
| | | | humidity (as %) | organic content (as %) | pH of medium | M. polita | other species |
| 20 | March 28, 1956 | Plant compost | 41.01 | 19.77 | 7.05 | 12 | — |
| 73 | April 7, 1957 | » » | 49.71 | 9.55 | 7.18 | 1 | *Ophyra leucostoma* Wd. — 10<br>*Fannia manicata* Mg. 3<br>*Fannia canicularis* L. — 2 |
| 76 | April 15, 1957 | » » | 58.66 | 12.91 | 6.98 | 27 | *F. manicata* Mg. — 7<br>Not det. — 2 |
| 91 | Sept. 13, 1957 | » » | 52.45 | 14.46 | 6.98 | 431 | *Fannia* sp. — 5 |
| 118 | April 17, 1958 | Pig manure and plant compost | 50.36 | 22.1 | 5.35 | 96 | *Seoptera vibrans* L. — 6<br>*Dolichopus plumipes* Scop. — 5 |

and a pH value of approximately 7 (except for samples of pig dung, where the pH was somewhat higher). Biotopes yielding negative results were found to depart from these values in respect of one or other of the three factors. It is obvious however, that the essentials for existence in the case of M. polita cannot be expressed merely in terms of humidity, organic content and pH of the substrate.

M. polita larvae live in a medium where the processes of bacterial decomposition and fermentation are taking place. The latter feature of the substrate is, no doubt, the cause of this species having acquired a high degree of resistance to alcohol. The author has noticed that when larvae are placed in cold alcohol in order to fix them, they may survive an hour and a half in 70% alcohol. Twelve larvae of the species under consideration were placed in 96% alcohol, and another 12 larvae in 50% alcohol. They died after 40 minutes in 96% alcohol, although one individual survived for an hour. In 50% alcohol 7 larvae died during the first two hours, but five individuals showed signs of life after being immersed in the alcohol for 18½ hrs.

The liter sample method demonstrated that the M. polita overwinters as a fully grown larva. Observations on the overwintering of this species were carried out in the following way. Larvae were removed from clumps of rotting plant remains on September 13th, 1957 [Sample No. 91] and divided into three groups; after which each group, together with a portion of the substrate, was placed in a glass vessel. Group I [100 larvae] was kept in the laboratory at a temperature of 15°-21° for the whole of the experiment. Group II [100 larvae] was also kept in the laboratory at a temperature of 15°-21° until November 14th, 1957, when they were rapidly cooled to -12°, at which temperature they remained for 15 days. Group III [231 larvae] were kept for 1½ months [from November 14th, 1957 to January 3rd, 1958] at a temperature of -1° to -2°, after which they were transferred back to laboratory conditions [temperature 15°-21°]. It should be stated that from December 30th to January 3rd the refrigerator was turned off on three occasions and the temperature rose to 10°.

On April 17th, 1958, a sample [No. 118] was taken from a two-year old heap of pig manure, near to which had been deposited piles of rotting vegetable remains. The sample contained 96 larvae of M. polita which were removed to a glass vessel together with some of the substrate and maintained in the laboratory at a temperature of 15°-21°.

All four groups were kept under observation until October, 1958. When the substrates became dry they were moistened periodically, but apart from this the cultures received no special treatment. The results of our observations are shown in Table 5.

This table reveals that of the larvae which were not subjected to a temperature below freezing point, only 14% gave rise to adult flies and only 5% attained this stage of development during the Spring. Larvae which had been frozen for 15 days at a temperature of -12°, gave a 33% emergence of adults, whereas those frozen for 1½ months at a temperature of -1° to -2° gave a 56% emergence. Overwintering of larvae under natural conditions gave an emergence of 48%. This enables us to say that M. polita undergoes a winter diapause as a full-grown larva. Further support is given to this belief by the fact that full-grown larvae can be found in rotting vegetation as early as the end of July, although no autumnal emergence of adults takes place.

The effect of temperatures below freezing point is to speed up the process of diapause, which therefore ensures a greater survival of the pre-imaginal stages [Table 5]. It is obvious, however, that a certain percentage of larvae are able to develop without diapause (these constitute the autumnal emergence of isolated males) or, alternatively, this minority may be able to terminate diapause without their being frozen. In this latter case, the period of diapause is extended to two and a half months.

TABLE 5 Time of Emergence Among Adult Michrochryza polita Overwintering as Larvae under Various Conditions

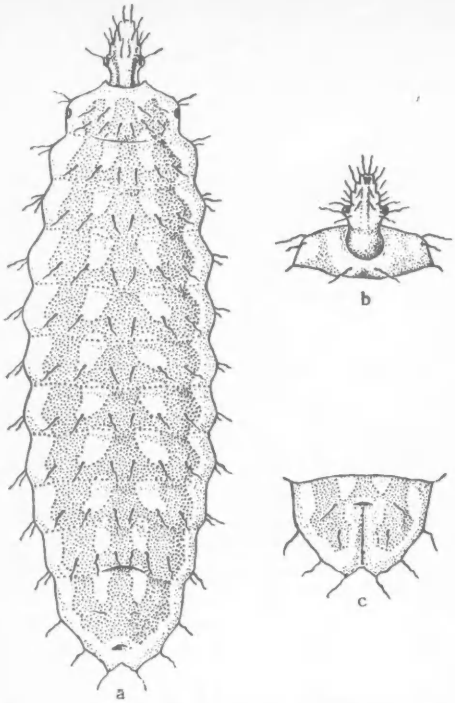
| Months in 10-day periods | In laboratory without freezing | | | With freezing: from 14-29 Nov. at -12° | | | from 14 Nov.-3 Jan. at -1 to -2° | | | under natural conditions until Apr. 17 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ♂♂ | ♀♀ | total | ♂♂ | ♀♀ | total | ♂♂ | ♀♀ | total | ♂♂ | ♀♀ | total |
| Sept. . . . | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | — | — | — |
| Oct. . . . | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | — | — | — |
| Nov. III . . | 1 | 0 | 1 | — | — | — | — | — | — | — | — | — |
| Dec. I . . . | 1 | 0 | 1 | 0 | 0 | 0 | — | — | — | — | — | — |
| » II . . . | 0 | 0 | 0 | 4 | 2 | 6 | — | — | — | — | — | — |
| » III . . . | 0 | 0 | 0 | 7 | 6 | 13 | — | — | — | — | — | — |
| Jan. I . . . | 0 | 0 | 0 | 2 | 2 | 4 | 0 | 0 | 0 | — | — | — |
| » II . . . | 0 | 0 | 0 | 3 | 1 | 4 | 0 | 0 | 0 | — | — | — |
| » III . . . | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | — | — | — |
| Feb. I . . . | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | — | — | — |
| Mar. . . . . | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | — | — | — |
| Apr. III . . . | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| May, I . . . | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 1 | 12 | 3 | 1 | 4 |
| » II . . . | 0 | 1 | 1 | 0 | 0 | 0 | 6 | 1 | 7 | 0 | 0 | 0 |
| » III . . . | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 5 | 25 | 14 | 4 | 18 |
| June, I . . . | 0 | 0 | 0 | 0 | 0 | 0 | 31 | 33 | 64 | 5 | 14 | 19 |
| » II . . . | 0 | 1 | 1 | 0 | 1 | 1 | 8 | 11 | 19 | 1 | 4 | 5 |
| » III . . . | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 |
| July, I . . . | 1 | 2 | 3 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| » II . . . | 1 | 0 | 1 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| » III . . . | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aug. I . . . | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| » II . . . | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| » III . . . | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sept. . . . | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Totals . . . | 7 | 7 | 14 | 18 | 15 | 33 | 76 | 54 | 130 | 23 | 23 | 46 |
| % emergence . . . . | 7 | 7 | 14 | 18 | 15 | 33 | 33 | 23 | 56 | 24 | 24 | 48 |

The autumnal larvae, which do not undergo any diapause, give nothing but males. Among certain larvae, which also give rise to males, the diapause terminates in November [see Table 5]. In other cases, the main emergence of males takes place earlier than that of the females. It is obvious, therefore, that those larvae destined to give rise to males terminate their diapause more speedily than those which will give rise to females.

The numbers of M. polita in the field must, to some extent, be influenced by predators. We have frequently found the remains of this species, in the form of an empty cuticle, on the leaves of black-currant bushes. Certain of these remains were surrounded by silken strands, suggesting the work of spiders. In the laboratory, observations have been made on the capture of female M. polita by the spider, Scopeuma stercorarium L. It appears that this species is able to capture M. polita successfully, and in nature it undoubtedly includes the latter in its diet.

As far as we have been able to ascertain, the larval morphology of M. polita has not been described in the literature. We propose, therefore, to include in this paper a figure of the full grown larva of this species, together with a short account of its morphology.

The body of the larva is dorso-ventrally flattened. Its dorsal side is more convex than the ventral. The cuticle resembles shagreen leather and is yellowish-brown in color. There are broad, dark-colored patches on both thoracic and abdominal segments; these patches are joined together by bridges of pigmentation along the breadth of the segment and they appear trapeziform in outline. The effect of this coalescence of pigmentation is to produce three dark-colored stripes running the length of the dorsal and ventral sides of the larvae. The head is clearly demarcated from the rest of the body but it can be withdrawn into the thorax on occasion. On each side of the head there is a pigmented tubercle, which appears to function as a light-sensitive organ. The mouthparts are poorly developed and can only be recognized with difficulty as small protuberances on the ventral side of the head. The first thoracic segment bears two sclerotinized plates laterally; on these plates are the anterior stigmatal apertures. The apertures of the posterior stigmata open into small depressions on the dorsal side of the anal segment. A few yellowish-brown hairs are scattered over the whole body surface. On every segment (apart from the oral, thoracic and anal segments) there is a single row of hairs, consisting of 10 members on the dorsal side and 10 on the ventral. The anal aperture is hidden by the ventral portion of the anal segment. Body length 7 mm, breadth 2 mm.




Microchryza polita L. Larva. a) as seen from dorsal aspect; b) front end of larva in ventral view; c) posterior end of body in ventral view.

Young larvae are whitish-grey, and do not have the dark-colored patches on the segments. The alimentary canal is visible through the cuticle as vague elongate dark-colored patches.

## SUMMARY

Among the species of synantropic flies of the town of Ivanovo, Microchryza polita L. (Diptera, Stratiomyiidae) is a common species.

M. polita are found on the leaves of different plants, in gardens, on apples, etc. Emergence begins in the middle of May and goes on till the middle of August. Flies are most numerous at the end of June and the beginning of July. Sometimes they fly into the human dwellings.

Hatching occurs in accumulations of decomposed herbaceous plants mixed sometimes with wastes (cess-pits) and manure. Under certain conditions these flies usually carry the pathogenic microflora and pollute plants in gardens and kitchen-gardens.

M. polita is a monocyclic species.

The larvae of M. polita possess a high resistance to alcohol. In our tests the duration of larval life has reached to 1 hr in 96° alcohol. After 1.5 hrs in 70° alcohol, nearly half of the experimental larvae survived after their maintenance in 50° alcohol for 18.7 hrs. The larval resistance to alcohol is thought to appear in connection with their development in mediums with rapid processes of fermentation.

M. polita has a winter diapause in the adult larval stage. Sharp variations of the temperature from +20°C to -12°C within the period before a diapause and in a week do not kill larvae. The negative temperature accelerates the period of diapause and increases the rate of emergence of imagos. According to observations on the larvae, hibernating in different temperature conditions, the emergence of flies from larvae, not having undergone the influence of negative temperatures, is more prolonged and is finished 2.5 months later than the emergence from the larvae hibernating under natural conditions. Reactivation of larvae, from which males develop, occurs within shorter periods than those from which females develop; some of them can develop without diapause.

Sometimes the larvae of M. polita migrate from the substratum to surface layers or to contiguous plots of soil; under the laboratory conditions, to the walls of vessels.

The body of the larvae of M. polita is flattened dorso-ventrally; the ring of hair at the posterior end of the body around posterior stigma is absent. Larvae dimensions: 7 mm length, 2 mm breadth.

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# ON THE MORPHOLOGY AND BIOLOGY OF SYNANTROPIC SPECIES OF THE GENUS FANNIA R. D. (DIPTERA, MUSCIDAE)

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Synantropic species of the genus Fannia R. D. are very numerous in all the populated areas which may be found in different landscape and climatic conditions.

The following 3 species have the most important epidemiological significance in Central Asia: Fannia canicularis L., F. scalaris F. and F. leucosticta Mg.; F. incisurata Zett. is a less common species, while F. subscalaris Zim. has so far been found only in Tadzhikistan (Zimin, 1944a, 1944b, 1945) and in Samarkand (Sychevskaya, 1954, 1956, 1958).

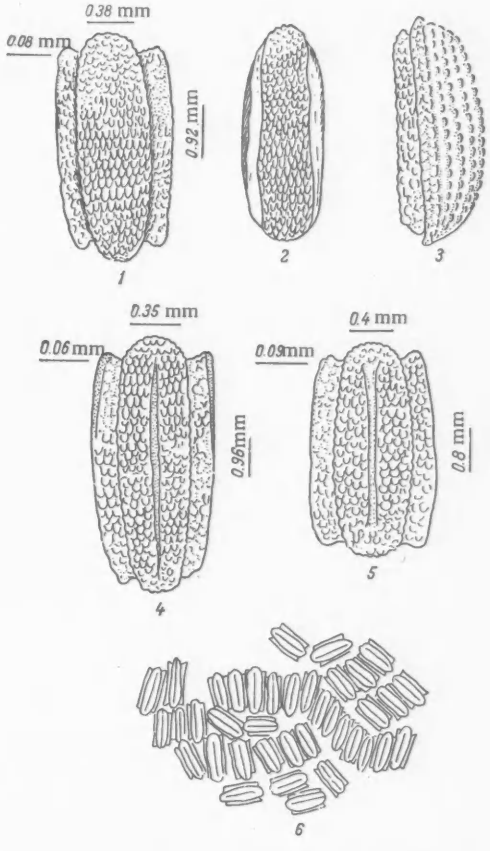
This communication will present certain new data on the morphology and biology of species of Fannia in Uzbekistan, according to observations made during 1949-1957.

## 1. Morphology of Eggs and of the Female Reproductive System of Fannia

Porchinskii (1910) was the first to observe the presence of "alae" on both sides of the eggs of F. canicularis, and their opening during oviposition. As noted previously, (Sychevskaya, 1954), the eggs of the three species of Fannia are clearly distinguished by the structure of their exochorion. Numerous irregular cells may be seen on the outer surface of the egg shell. The eggs of F. canicularis either do not possess a medial longitudinal line (Figs. 1 and 2), or it may be only faintly visible. The posterior surface of the egg is convex, with convex longitudinal sculptured ridges, which apparently help in securing the egg more firmly in the substrate (Fig. 3). The eggs of F. scalaris are more elongate; there is a longitudinal convex line along the middle, which is tapered at the ends (Fig. 4). In the eggs of F. leucosticta this line becomes widened at the ends (Fig. 5). The eggs of this species appear wider than the eggs of the two other species.

The length/width ratio in the eggs of F. leucosticta is 2.0, of F. canicularis it is 2.4, and of F. scalaris, 2.7, so that the eggs of the last-named species are narrower and longer than those of the other species of Fannia.

The females of the three above-mentioned species of Fannia are very well distinguished from each other by the structure of their reproductive organs, (seminal receptacles and accessory glands), so that the number of seminal receptacles and the morphology of the accessory glands may be used as additional and reliable systematic characters which characterize these species. F. canicularis has 2 large seminal receptacles and its accessory glands have a well-defined constriction in the middle (Fig. 7). F. scalaris has 3 seminal receptacles and oval accessory glands (Fig. 8). F. leucosticta has 2 seminal receptacles of a correspondingly smaller size and elongate accessory glands with a small




Figs. 1 - 6. Eggs of Fannia. 1) deposited egg of F. canicularis; 2) same, during emergence from the ovipositor; 3) same, lateral view; 4) egg of F. scalaris E; 5) egg of F. leucosticta Mg.; 6) group of eggs of F. scalaris F.

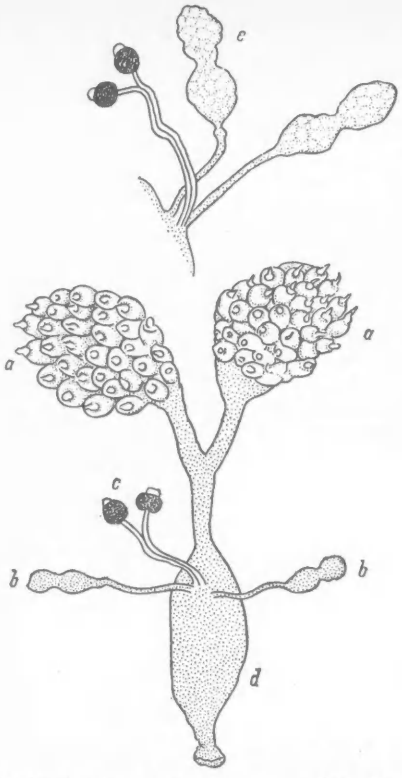



Fig. 7. Female reproductive organs of Fannia canicularis L. a) ovaries; b) accessory glands; c) seminal receptacles; d) uterus; 3) accessory glands and seminal receptacles, greatly enlarged.

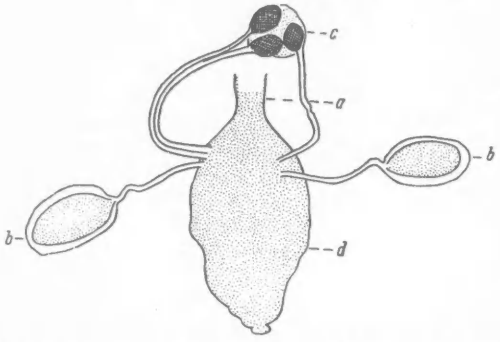



Fig. 8. Female reproductive organs of Fannia scalaris F., (without ovaries). a) part of the unpaired oviduct; b) accessory glands; c) seminal receptacles; d) uterus.

indentation in the middle (Fig. 9). The seminal receptacles and the accessory glands of F. subscalaris and F. scalaris are identical on gross examination. There are no evident differences in the structure of the ovaries of the 3 species, except their size and the number of egg tubules.

The ovaries of F. canicularis consist of 40-100 egg tubules, those of F. scalaris of 80-100, and those of F. leucosticta of 30-50 (Sychevskaya, 1954). The uterus is well developed in the genus Fannia.

## 2. Vivipary in Fannia

The original data on vivipary in Muscidae is found in Porchinskii (1885, 1910).

According to Keilin (1916), some species of flies, which deposit eggs under normal circumstances, are able to give birth to one or several larvae if oviposition is delayed. Keilin observed vivipary in Aphiochaeta, Phora, Calliphora and Musca, which were captured in nature and kept in an empty vessel. Séguy (1950) reviewed all known types of vivipary in flies and gave facts of accidental vivipary in Chrysomiya (according to Roubaud, 1911), and in some other species of flies which normally deposit eggs.

Accidental vivipary in Fannia was observed in Samarkand in 1949 (12 cases in F. canicularis, 3 in F. scalaris and 6 in F. leucosticta). In 3 cases the larvae emerged from the eggs which protruded from the ovipositor of F. canicularis (Fig. 10), and in the other cases from eggs extracted from the ovipositors of just-captured flies, when they were dissected in a drop of water on a slide (Fig. 11). Table 1 shows all the cases of vivipary in Fannia, together with the locality, date and time of capture of the females.

In Samarkand in the summer, the larvae of Fannia hatch from the eggs 30-40 hrs after oviposition (Sychevskaya, 1954), but this depends on whether the egg was deposited immediately after its fertilization, or after a varying period of time, during which the egg is retained in the uterus while the development of the larva takes place. Cousin (1932) expressed similar considerations in connection with the development and the deposition of eggs of Lucilia sericata Mg.

Of the 12 cases of vivipary in F. canicularis, 9 cases relate to females which were captured on walls of a cellar which served as their day-time haven, or near it on chicken droppings at 6 p.m., immediately after the flies left the cellar. During July and August, F. canicularis spent the 8-9 hottest daylight hours in this cellar in a condition of almost complete immobility, which explains the delay in oviposition, which, in turn caused the development of the larvae within the uterus. The other cases are related to females captured during the morning hours, when they have still not deposited, for some reason, the eggs which should have been deposited the day before. Living larvae in the eggs of Fannia were not found in the autumn, winter and early spring, although large numbers of females were dissected during these seasons in the period between 1949 and 1952.

## 3. Fannia subscalaris Zim

F. subscalaris Zim., described by L. S. Zimin from Tadzhikistan in 1945, is the fifth synantropic genus of Fannia in Central Asia. Both the sexes of this species, which are well distinguished morphologically from A.

TABLE 1 Accidental Vivipary in Fannia

| Species | Place of capture | Date | Hour | Number of flies: captured and dissected | Number of flies: those with a larva containing egg |
|---|---|---|---|---|---|
| *Fannia canicularis* L. | wall of cellar, daylight haven of flies | July 4 | 18 | 4 | 2 |
| | | July 6 | $12^{30}$ | 10 | 4 |
| | | July 9 | $11^{30}$ | 7 | 1 |
| | market, on fruits | July 22 | 8 | 2 | 1 |
| | | Aug. 12 | $7^{30}$ | 4 | 2 |
| | chicken droppings near cellar | Aug. 25 | 18 | 2 | 2 |
| | | Total | — | 29 | 12 |
| *Fannia scalaris* F. | lived in trap (4 days) | April 11 | — | 1 | 1 |
| | pig manure | Aug. 25 | 10 | 7 | 1 |
| | in latrine, flying in | Sept. 21 | 10 | 8 | 1 |
| | | Total | — | 16 | 3 |
| *Fannia leucosticta* Mg. | chicken droppings | June 23 | $10^{30}$ | 1 | 1* |
| | latrine feces | July 14 | 11 | 5 | 2 |
| | market, fruits | Aug. 25 | 8 | 24 | 3 |
| | | Total | — | 30 | 6 |

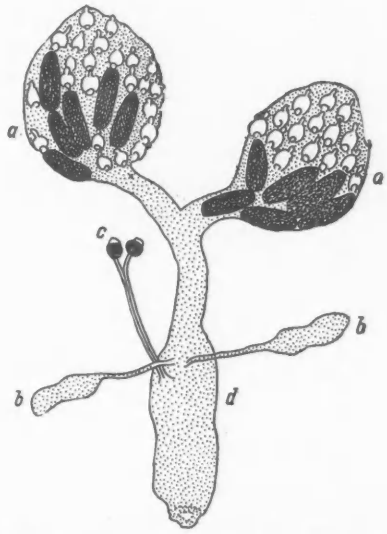



Fig. 9. Female reproductive organs of Fannia leucosticta Mg. a) overies; b) accessory glands; c) seminal receptacles; d) uterus.

scalaris, were discovered among specimens of the latter.

F. subscalaris is rarely found in Uzbekistan; during 10 years of year-round collections and observations numerous populated localities of this republic, in various landscape zones, only about 200 specimens were collected and reared, while Zimin dealt with 1210 specimens of this species from the Gissar and the Vakhsh valleys.

F. subscalaris develops in the same substances as F. scalaris, i.e., in manure, latrines (usually deep ones, containing semiliquid substrate), in piles of feces on the ground, in pig and chicken manure, but always in small numbers (Sychevskaya, 1954, 1956) (Table 2).

During 1949-1957 only 21 specimens were reared in 13 trials made in 5 populated localities of the republic (7 females and 14 males), which constitutes 0.28-5.6 % when related to other accompanying species.

F. subscalaris is rarely captured by means of nets, test-tubes and screen fly-traps (Table 3), where it constitutes 0.54-2.06% in relation to other species of flies, captured simultaneously.

It was mentioned earlier, that in the references cited above, of 100 dissected females of F. subscalaris, captured by means of a fly trap in a latrine, only 2 had normally developed reproductive organs. Table 4 gives the results of dissection of 100 females and 55 males during 1949-1952. In 33% of the females both the ovaries were more or less underdeveloped (Figs. 12, 13), while in 63% the ovaries were absent altogether (Figs. 24, 25). Of the 55 dissected males, only 3 had no testes.

It must be noted that in all the 13 females (Tables 2 and 3) the ovaries were also absent. During 1950, six females without ovaries and 1 male with one apparently normal testis, but containing very few spermatozoa, and the other testis being small and shriveled, were captured in a latrine, as they were flying into it. Thus, only 2 females (1.67%) of the total of 119 dissected had normally developed ovaries.

All the examined specimens of F. subscalaris (males and females), were newborn. Old flies were never found,

TABLE 2 Hatching of Fannia subscalaris Zim. and of Accompanying Species in 5 Populated Localities of Uzbekistan

| Locality | Substrate | Date of collection | Date of hatching | No. specimens female | No. specimens male | Accompanying species | No. of specimens | % specimens F. subscalaris Zim. |
|---|---|---|---|---|---|---|---|---|
| Samarkand | Latrine feces | 1949 Aug. 18 | 1949 Sept. 7 | 1 | — | *Fannia scalaris* F. | 25 | 3.8 |
| | | Sept. 8 | Oct. 1 | — | 1 | *F. scalaris* F., | 20 | 3.7 |
| | | | | | | *F. canicularis* L., | 2 | |
| | | | | | | *Dendrophaonia querceti* Bché. | 4 | |
| | | Sept. 18 | 1950 91 | — | 1 | *F. scalaris* F., | 30 | 2.5 |
| | | | | | | *F. canicularis* L., | 6 | |
| | | | | | | *D. querceti* Bché. | 3 | |
| | | Nov. 29 | Jan. 2 | — | 1 | *F. scalaris* F. | 3 | — |
| | | Dec. 2 | Jan. 2 | — | 1 | *F. scalaris* F., | 10 | 1.6 |
| | | | | | | *F. leucosticta* Mg., | 50 | |
| | | | | | | *Scopeuma stercorarium* L. | 1 | |
| | Pig manure | Sept. 17 | Oct. 14-20 | 2 | — | *F. scalaris* F., | 35 | 3.7 |
| | | | | | | *Muscina stabulans* Flln., | 10 | |
| | | | | | | *M. assimilis* Flln., | 2 | |
| | | | | | | *D. querceti* Bché. | 5 | |
| | Chicken droppings | Dec. 7 | Jan. 9 | — | 1 | *F. scalaris* F., | 10 | |
| | | | | | | *Leria* sp. | 1 | |
| Village Urgut in Samarkand region | Latrine feces | 1953 Nov. 20 | 1954 Jan. 5-27 Feb. 1-10 | 3 | 5 | *F. scalaris* F., | 86 | 5.6 |
| | | | | | | *F. canicularis* L., | 5 | |
| | | | | | | *F. leucosticta* Mg., | 7 | |
| | | | | | | *D. querceti* Bché., | 5 | |
| | | | | | | *Musca d. vicina* Meq., | 17 | |
| | | | | | | *Hydrotaea dentipes* F., | 3 | |
| | | | | | | *Paregle cinerella* Flln., | 2 | |
| | | | | | | *Scopeuma ctercorarium* L., | 8 | |
| | | | | | | *Madiza glabra* Flln. | 2 | |
| | Ditch with feces | Nov. 24 | Dec. 18 | | 1 | *F. scalaris* F., | 80 | 1.16 |
| | | | | | | *F. leucosticta* Mg., | 3 | |
| | | | | | | *Ophyra leucostoma* Wd., | 1 | |
| | | | | | | *Hydrotaea armipes* Flln. | 1 | |
| | Pile of feces on the ground | Nov. 20 | Jan. 4 | 1 | | *F. scalaris* F., | 96 | 0.8 |
| | | | | | | *D. querceti* Bché., | 24 | |
| | | | | | | *Physiphora demandata* F., | 2 | |
| | | | | | | *Coprosarcophaga haemorrhoidalis* Flln. | 1 | |

TABLE 2 (continued)

| Locality | Substrate | Date of collection | Date of hatching | No. specimens female | No. specimens male | Accompanying species | No. of specimens | % specimens F. subscalaris Zim. |
|---|---|---|---|---|---|---|---|---|
| | | 1954 | 1954 | | | | | |
| Karshi | Latrine feces | Oct. 18 | Oct. 26 | | | *F. scalaris* F., | 12 | 1.6 |
| | | | | | | | 2 | |
| | | | 1955 | | | | 26 | |
| | | | Jan. 17 | | | *F. canicularis* L., | 11 | |
| | | | Feb. 8 | | | *F. leucosticta* Mg., | 4 | |
| | | | | | | *O. anthrax* Wd., | 4 | |
| | | | | | | *P. cinerella* Flln. | 1 | |
| | | | | | | *Musca sorbens* Wd.. | | |
| | | | | | | *Ravinia striata* F. | 125 | |
| | | 1955 | | | | | 5 | |
| Fergana | Same | June 17 | July 4 | — | 1 | *F. scalaris* F.; | 210 | 0.28 |
| | | | | | | *M. stabulans* Flln., | 12 | |
| | | | | | | *D. querceti* Bché., | | |
| | | | | | | *M. d. vicina* Mcq. | 12 | |
| | | 1957 | 1957 | | | | 30 | |
| Termez | Same | July 18 | July 29 | — | 1 | *F. scalaris* F., | 22 | 1.5 |
| | | | | | | *F. leucosticta* Mg., | | |
| | | | | | | *O. anthrax* Wd. | | |

TABLE 3 Capture of Fannia subscalaris Zim. and of Accompanying Species in 3 Populated Localities of Uzbekistan

| Locality | Place of capture | Date | Number female | Number male | Accompanying species | No. of specimens | % specimens F. subscalaris |
|---|---|---|---|---|---|---|---|
| | | 1949 | | | | | |
| Samarkand | Market, melon peels, during 15 minutes | Aug. 5 | 2 | 2 | *F. scalaris* F., | 187 | 2.06 |
| | | | | | *F. canicularis* L. | 3 | |
| | Latrine, inair, with net, one trial | Aug. 8 | 2 | — | *F. scalaris* F., | 2 | |
| | | | | | *D. querceti* Bché. | 13 | |
| | From latrine | Oct. 10 | — | 1 | *F. scalaris F.* | 21 | |
| | | 1953 | | | | | |
| Urgut | In screened fly traps | June 11 | 1 | — | *F. scalaris* F., | 28 | 1.7 |
| | | | | | *F. canicularis* L., | 2 | |
| | | | | | *M. stabulans* Flln., | 2 | |
| | | | | | *O. leucostoma* Wd., | 17 | |
| | | | | | *H. dentipes* F., | 7 | |
| | | | | | *M. domestica vicina* Mcq., | 1 | |
| | | | | | *Pollenia rudis F.*, | 1 | |
| | | | | | *Lucilia sericata* Mg. | 1 | |
| | Market on beer cases, during 1 hr, in sunlight | Nov. 23 | 1 | — | *F. scalaris* F. | 7 | |
| | | 1957 | | | | | |
| Dzhar-Kurgan | Market, on beer cases during 1 hr, in sunlight | Mar. 14 | — | 1 | *F. scalaris* F., | 1 | 0.54 |
| | | | | | *F. canicularis* L., | 11 | |
| | | | | | *M. stabulans* Flln., | 5 | |
| | | | | | *M. assimilis* Flln., | 1 | |
| | | | | | *Dasyphora asiatica* Zim., | 156 | |
| | | | | | *Musca d. vicina* Mcq., | 1 | |
| | | | | | *Pollenia rudis* F., | 3 | |
| | | | | | *Calliphora erythrocephala* Mg., | 2 | |
| | | | | | *Lucilia sericata* Mg., | 1 | |
| | | | | | *Ravinia striata* F., | 2 | |
| | | | | | *C. haemorrhoidalis* Flln. | 1 | |

TABLE 4 Results of Examination of Fannia subscalaris Zim., Captured by Means of a Fly Trap in a Latrine in Samarkand, during 1949 - 1952.

| | Females | | | | | Males | | | |
|---|---|---|---|---|---|---|---|---|---|
| | number of flies | both ovaries normal | 1 ovary normal | both ovaries rudimentary | with stump instead of ovaries | number of flies | both testes normal | one testis normal | both testes absent |
| 1949 . . . | 8 | 0 | 0 | 4 | 4 | 2 | 1 | 1 | — |
| 1950 . . . | 78 | 2 | 0 | 20 | 56 | 33 | 22 | 10 | 1 |
| 1951 . . . | 10 | 0 | 1 | 8 | 1 | 18 | 13 | 3 | 2 |
| 1952 . . . | 4 | 0 | 1 | 1 | 2 | 2 | 1 | 1 | — |
| Total . . | 100 | 2 | 2 | 33 | 63 | 55 | 37 | 15 | 3 |

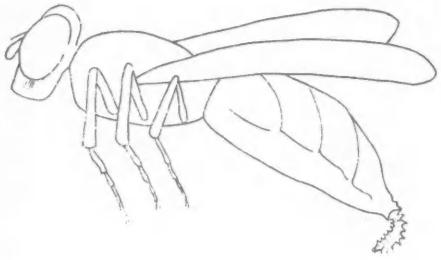


Fig. 10. Vivipary in Fannia canicularis L.

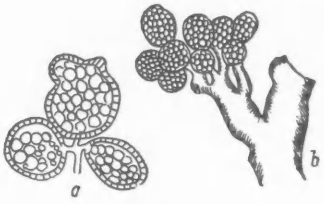



Fig. 12. Fannia subscalaris Zim. (Eyepiece 2, objective 3, Reichert microscope). a) egg follicles; b) underdeveloped ovary.

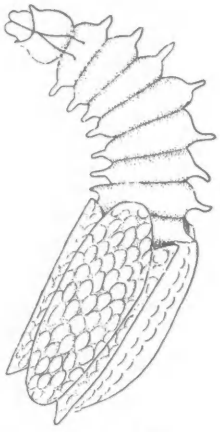


Fig. 11. Emergence of larva from the egg of Fannia canicularis L.

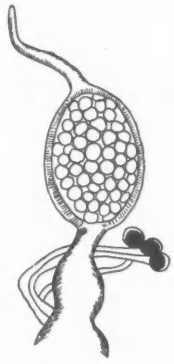


Fig. 13. Fannia subscalaris Zim., underdeveloped ovary.

which also points to the lack of vital ability of this species.

Hennig (1955) thought that F. subscalaris is an intersex, an intermediate sexual form (sexuelle Zwischenform); such forms were often found in F. scalaris and were repeatedly described as separate species.

It is known that DDT and hexachloro-cyclohexane are able to produce morphological and functional changes in different insect organs, including the ovaries of Eurygaster integriceps (stink bugs), (Fedotov and Bocharova, 1952) and in the housefly (Lineva, 1955). But the estate where the flies were caught was not treated during 1949-1951 with chlorinated hydrocarbons. Wanting to find the reason for such profound changes in the reproductive organs of F. subscalaris, we performed several experiments in

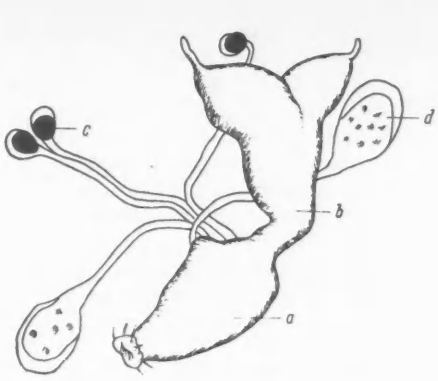



Fig. 14. Fannia subscalaris Zim., undeveloped ovaries. a) uterus; b) unpaired oviduct; c) seminal receptacles; d) accessory gland.

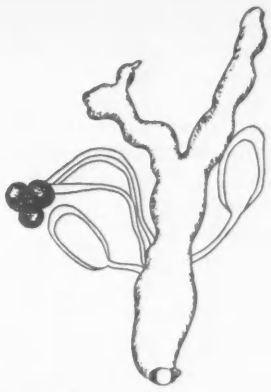


Fig. 15. Fannia subscalaris Zim., undeveloped ovaries.

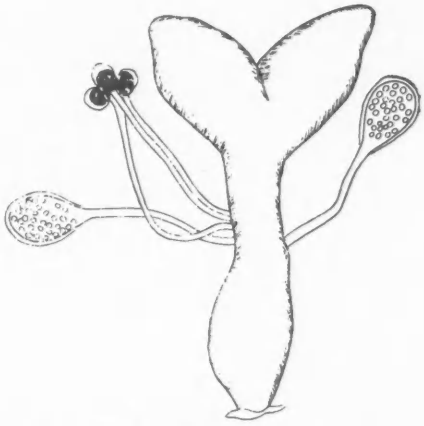


Fig. 16. Fannia scalaris F., undeveloped ovaries; fly cultured in feces treated with hexachloro-cyclohexane.

Fig. 17. Fannia scalaris F., underdeveloped ovary; fly cultured in feces treated with hexachloro-cyclohexane.

1951, in which 3rd stage larvae of F. scalaris (those of F. subscalaris being unavailable), were cultured in feces treated with a 1% suspension of hexachloro-cyclohexane. Of the total of 496 larvae, almost all of which pupated, only 82 flies emerged (43 females and 37 males of F. scalaris and 2 females of F. subscalaris), the rest having died in the puparia as fully developed flies. Of the 43 females of F. scalaris, 1 had no ovaries (Fig. 16) and 1 had an underdeveloped ovary, consisting of 2 large egg tubules (Fig. 17). Both the females of F. subscalaris also had no ovaries. In a similar experiment with 10 larvae during September, 1957 in Termez, we obtained 1 female of F. scalaris with apparently normal ovaries, but with strongly vacuolated primary follicles in the egg tubules.

In normal populations of F. scalaris such pathological changes are seen very rarely. Only 2 of almost 10,000 females of F. scalaris, either captured of cultured, had underdeveloped ovaries, and in one of these the hindgut was infected with a fungal mycelium.

It must be added that neither helminths, which, according to Polozhentsev (1954), are able to cause complete castration in insects, nor protozoa were found in the F. subscalaris examined. Apparently, F. subscalaris, in spite of its clear external morphological differences from F. scalaris, is an aberrant, unviable form of the latter.

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# THE WATER VOLE (Arvicola terrestris L.) - A NEW HOST OF THE WARBLE FLY, Oestromyia leporina Pall. (DIPTERA, HYPODERMATIDAE)

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Translated from Éntomologicheskoe Obozrenie Vol. 39, No. 2, pp. 361-363, April-June, 1960

The warble fly, Oestromyia leporina Pall.* is a very widespread species belonging to the genus Oestromyia Br. Its area of distribution extends from West Europe to Kamchatka, from the estuary of the Lena to Gimalaev. The chief host of this species appears to be the pica (Ochotona Link.); it parasitizes other rodents only in a few mountainous regions from which picas are absent. At the present time picas are absent from Caucasia. Their fossil remains are known only from Armenian SSR (the Aiotsdzorsk and Urtski ranges of mountains). These remains are 3-4 thousand years old. In Caucasia, O. leporina Pall. was found only twice. In the collections of the Zoological Institute of the Academy of Science, SSSR, grubs of this warble fly are preserved with the vole (Microtus majori Thom.) from Asia Minor, a few specimens of which were caught by I. M. Gromov on the mountain slopes of Greater Bambak (Krasnodar region, in the grounds of the Caucasian state national forest between the rivers Kisha and Urushten) and with the vole (Microtus sp.) caught near the village of Semenovka (Sevan district of Armenian SSR). The species has not yet been met with in the Stavropol region.

From all the collections of ectoparasites obtained by the scientific research expeditions of the Anti-plague Institute of Caucasia and Trans-Caucasia during the periods May 27 – August 1, 1958 and from July 12-27, 1959, 1702 rodents were examined, caught in various ecological zones in the mountain districts of Stavropol region and in Kabardin–Balkar ASSR (from the upper course of the Greater Laba river to the outlet of the river Baksan in the east). According to the species composition and numbers of individuals, the rodents examined were distributed as follows: Sciurus vulgaris L. (3), Citellus pygmaeus Pall. (368), Dyromys nitedula Pall. (3), Sicista betulina Pall. (1), S. caucasica Vinogr. (3), Rattus norvegicus Berk. (2), Mus musculus L. (87), Apodemus agrarius Pall. (32), A. sylvaticus L. (407), Cricetus cricetus L. (25), Cricetulus migratorius Pall. (4), Arvicola terrestris L. (572), Microtus arvalis Pall. (99), M. majori Thom (72), M. gud Satun. (20), M. roberti Thom (1), Lepus europaeus Pall. (3).

The larvae of O. leporina Pall. were observed only on the water vole (Arvicola terrestris rufescens Satun.), caught in the neighborhood of the village of Upper Mara at a height of 1700m above sea level (Karachev district) of Karachev–Cherkess AO) and in the Pokun-Syrt area at a height of 2000m above sea level (Little Karachev district of Karachev–Cherkess AO). Both places are situated

*For the determination of the species and for data on its distribution the author is indebted to K. Ya. Gruninu (Zoological Institute AN SSSR).

TABLE 1 Infestation of the Water Vole by the Larvae of the Warble Fly Oestromyia leporina Pall. in Various Habitats

| Date | Collected at:– | Voles caught | | Infested % |
|---|---|---|---|---|
| | | total | infested | |
| July 25-26, 1959 | Village of Upper Mara, southern slopes of the Skalist range, banks of river sources. . . . . | 16 | 2 | 12.5 |
| July 26-27, 1959 | Pokun–Syrt area, 6 km north of the Kum–Bashi Pass, banks of river-sources. . . . . | 8 | 3 | 37.5 |
| July 27-28, 1959 | Pokun–Syrt area, 10 km north of Kum–Bashi Pass, sub-alpine high grass . . . . . | 87 | 36 | 41.4 |
| | | 111 | 41 | 36.9 |

TABLE 2 Infestation by the Larvae Oestromyia leporina Pall. in Relation to the Sex and Size of the Water Vole

| Age and size of water vole | Voles caught | | Infested % |
|---|---|---|---|
| | total | infested | |
| Young animals . . . . | 26 | 5 | 19.2 |
| Old males . . . . | 46 | 21 | 45.7 |
| Old females . . . | 39 | 15 | 38.5 |
| | 111 | 41 | 36.9 |

in the Skalist mountain range which begins on the meridian of Maikop and extends southeast as far as the Andiisk range in Dagestan ASSR.

In Caucasia, the water vole is distributed from the level of the Caspian Sea up to 2800m above sea level. Under conditions existing in the Stavropol region it is very common on wooded steppes and sub-alpine zones of the mountainous districts. On the Skalist range its colonies are located in sub-alpine meadows on the banks of numerous streams and swamps. The numbers of water voles undergo large fluctuations. In years of mass increase this species produces enormous colonies over tens of thousands of hectares with large numbers of individuals (over 300 individuals per hectare); in years of depression only a few animals are preserved, the colonies being far removed from one another. In 1958 and 1959 the numbers of water voles were low (2–10 per km of river bank) with the exception of local colonies, small in area, in the cow-parsley (Heracleum) high grass country of Pokun-Syrt (up to 332 individuals per hectare).

Water voles infested with warble fly larvae were caught on July 8–16, 1958 and July 24–26, 1959 on the southern slopes of the Skalist ridge from the foot to the Kum-Bashi Pass and near the Mara-Bashi Pass. In the Pokun-Syrt country, infested voles were caught on July 26-28, 1959, 6—12km to the north of the summit of the Skalist ridge. The numbers of larvae per vole fluctuated from one to 18. The larvae were found under the skin on the head, back, flanks, abdomen and tail; most of them were in the region of the buttocks. The larvae do not develop all at the same time. On one and the same water vole "fistulas", left in the skin after the escape of the mature larvae, were found side by side with developing larvae. The hides as well as the furs from the water vole infested with warbles are considerably reduced in economic value.

The infestation of voles varies in different habitats (Table 1) and in relationship to sex and age (Table 2).

## SUMMARY

The water vole (Arvicola terrestris L.) is recorded for the first time as host of the warble fly (Oestromyia leporina Pall.) in the North Caucasus.

# ON THE SPECIES OF THE GENERA ALLIED TO Aphycus Mayr. (HYMENOPTERA, CHALCIDOIDEA) FROM THE EUROPEAN PARTS OF USSR

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The species of the group of genera, allied to Aphycus Mayr. (Encyrtidae) appear to be some of the most common and widely spread parasites of scale insects (Coccidea) Many of them are of economic importance and are used in the biological control of a large number of harmful pests. For example, Pseudaphycus malinus Gah. is widely known as a parasite of Comstock's scale insect (Pseudococcus comstocki Kuw.) and is specially imported into Central Asia and Trans-Caucasia from USA.

According to the data of Sweetman (1956, 1958), six species of this group, from a number of species introduced into USA, have been used successfully in the control of pests of citrus and other plants. In the control of certain coccids in USSR local parasites have been of great importance, for example, Blastothrix serica (Dalm,) and Aphycus apicalis (Dalm.). Nevertheless, the species of this group and the beneficial role they play have not been sufficiently studied. One realizes this particularly by the almost complete absence of work on the comparative morphology of the species of the various groups of genera, especially on the morphology of the abdomen, the shape of the sclerites of which are related to a number of evolutionary, important characters. Only recently has the work of Compere (1947) appeared, in which are given very concise descriptions of the abdominal sclerites in species from the genera Aphycus Mayr., Metaphycus Merc. and a few others. Consequently, the genera adopted by various authors are quite different and this leads to confusion when referring a species to this or that genus. The absence of research into the limits of variation of individual specific characters renders certain of them unreliable. This hinders the identification of even very common species and complicates the whole problem of the practical use of parasites.

In the present article, which does not pretend to be complete, an attempt is made to define more accurately certain generic and specific characters of the group under investigation. For convenience in the use of the identification tables, indices and details of the structure of the scutum of the mesonotum and parts of the ovipositor are given in Figs. 1-10.

From the European parts of USSR, especially from the south, altogether seven species in the group under discussion are recorded: Aphycus apicalis (Dalm.), Anaphycus nitens (Kurd.), Metaphycus punctipes (Dalm.), M. insidiosus Merc., Euaphycus asterolecanii Merc., Blastothrix serica (Dalm.), B. erythrostetha (Walk.) (Kurdjumov, 1912; Nikol'skaya, 1952; Telenga, 1954; Dyadechko, 1954; Rubtsov, 1954; Sugonyaev, 1958). During our researches in the Leningrad region we discovered 14 species of which two were new. The species Aphycus picearum Erd. is placed in a new genus Mesaphycus, gen. n., but the species Aphycus nitens Kurd. in the genus Anaphycus, gen. n. In this article 18 species are identified, belonging to eight genera, of which 11 are recorded for the first time in the fauna of the Leningrad region and 11 for the first time in the fauna of USSR. In addition to our collections the material in the collections of the Zoological Institute AN USSR were utilized.

All the types and material are preserved in the collections of the Zoological Institute AN USSR in Leningrad.

The coccids were determined by E. M. Dantsig.

## 1. Pseudaphycus austriacus Merc. (Figs. 11-15)

Female. Head in front a little wider than long, frons a little wider than the eye, frons and vertex approximately as long as wide, ocelli arranged in the form of an equilateral triangle. Gena rather less than 1.5 times as short as the longitudinal diameter of the eye. Distance between antennal pits approximately 1.5 times narrower than the frons. Mandible 3-toothed, the middle tooth projecting. Maxillary palps 4-jointed, labial palps 2-jointed. Scape of antenna slightly spindle-shaped, approximately equal in length to the pedicel and funicle, taken together. Pedicel as long as the four following joints of the funicle, taken together, almost as long as its breadth at the tip and almost 2.5 times shorter than the scape. All joints of the funicle are transverse, 5th joint twice as wide as long and almost twice as wide as the first joint of the funicle. Club elongated-oval, 1.5 times as wide as the 5th joint of the funicle, almost 1.5 times as long as the funicle. Wings thickly covered with hairs. A bare, oblique stripe, interrupted by 1-2 hairs somewhat below the middle and at the posterior edge. Marginal vein short, almost as wide as long and three times shorter than the radial vein; the latter is not clearly outlined at the tip. Post-marginal

TABLE OF THE GENERA IN THE GROUP APHYCUS MAYR. FROM THE EUROPEAN PARTS OF USSR.

1 (8). Seventh sternite reaches almost to the end of the abdomen: distance between its posterior edge and the tip of the abdomen (without the ovipositor) does not usually exceed $^1/_{10}$ the length of the abdomen (Figs. 26, 31). Scape of antenna spindle-shaped or linear.

2 (7). Ovipositor linear, about $^1/_3$ to $^1/_6$ the length of the abdomen, sheaths of ovipositor (3rd valves) long and narrow, not more than twice as short as the inner valves of the ovipositor. Mandible 3-toothed, with a long middle tooth.

3 (4). Funicle of antenna 5-jointed. Ninth abdominal syntergite transverse, its lateral lobe not developed (Fig. 13). Frons and vertex, taken together, approximately as long as broad. Antennae brown, club white. . . . . Pseudophycus Claus.

4 (3). Funicle of antenna 6-jointed. Club of antenna white or yellowish-white.

5 (6). Ocelli very small. Maxillary palp 3-jointed, labial palp 3-jointed. Pronotum wide; wings usually rudimentary. Ninth abdominal syntergite strongly transverse, without lateral lobes . . . . . Pezaphycus Nov.

6 (5). Ocelli of normal size. Maxillary palps 4-jointed, labial palps 3-jointed. Pronotum narrower; wings present. Ninth abdominal syntergite transverse with short lateral lobes . . . . . Aphycus Mayr.

7 (2). Ovipositor slightly expanded, sheaths of ovipositor short and wide, four times shorter than the inner valves of the ovipositor. Ninth abdominal syntergite curved in the form of a crescent with much longer lateral lobes. Mandible 3-toothed, the middle tooth not longer than the others. Body yellow, abdomen darkened above . . . . . Mesaphycus, gen. n.

8 (1). Seventh stemite does not actually reach the end of the abdomen: distance between its posterior edge and the tip of the abdomen is approximately equal to $^1/_3$ or $^1/_4$ the length of the abdomen (Fig. 34).

9 (14). Marginal vein short or almost undeveloped. Mandible 3-toothed.

10 (13). Scutum of mesonotum with distinct traces of parapsidial grooves. Maxillary palps 4-jointed, rarely 3-jointed; labial palps always 3-jointed.

11 (12). Scape of antenna slightly dilated and depressed, four times as long as wide. Club equal to or a little shorter than the funicle. Marginal vein comparatively developed, approximately 1.5 times shorter than the radial vein. The ninth abdominal syntergite wide, lateral lobes distinctly shortened (Fig. 70). Body black . . . . . Anaphycus, gen. n.

12 (11). Scape of antenna dilated and depressed, at the most three times as long as wide. Length of the club equal to the 3-4 preceding joints of the funicle, taken together. Marginal vein dot-shaped or absent. The ninth abdominal syntergite short (Fig. 36), with long lateral lobes. Color of body reddish, yellow to white, sometimes with the upper part brown or black . . . . . Metaphycus Merc.

13 (10). Scutum of mesonotum without traces of parapsidial grooves. Club of antenna as long as funicle. Maxillary palps 2- or 3-jointed, labial palps always 2-jointed . . . . . Euaphycus Merc.

14 (9). Marginal vein long, equal to the radial. Mandible with one tooth widely truncated, body with metallic luster . . . . . Blastothrix Mayr.

vein weakly developed and not clearly outlined. Spur of middle tibia a little shorter than the first joint of the middle tarsus, the latter equal in length to the three following joints, taken together. Abdomen almost as long as the thorax. The 9th abdominal syntergite strongly transverse, the lateral lobes absent, the lateral edges of the 9th syntergite forming approximately a right angle. The external valve of the ovipositor curved, approximately five times as long as its greatest width; apodemes very narrow, coinciding with the outer edges of the valve. Sheaths of ovipositor long and thin, somewhat less than twice as short as the inner valves of the ovipositor. The seventh abdominal sternite almost reaches the tip of the abdomen, V-shaped. Ovipositor protrudes to $^1/_3$ the length of the abdomen. Frons and vertex yellow-orange, sometimes yellowish-white. Antennae blackish, pedicel slightly whitish at the tip, first joint of the funicle and the club white. Mesonotum yellowish, darkened, front of scutum of the mesonotum and the axillae bordered with dark brown. Scutellum brownish at the tip. Pronotum, tegulae, sides and thorax white, central part of pronotum and tips of the tegulae slightly blackish. Wings transparent, darkened under the fold of the submarginal and radial veins. Legs white, tibia with blackish rings. Abdomen dirty-white with transverse blackish stripes, white underneath. Ovipositor blackish at the tip. Length 0.8 - 0.9 mm.

Male looks like the female. It differs in the club of the antenna being unsegmented, more strongly truncated

at the tip and somewhat curved and darkened at the base. Mesonotum dirty-yellow, scutellum with brownish markings reminiscent of an inverted cross. Length 0.8 - 0.9 mm.

Leningrad region: Pushkin, on grass, August 13, 1958, 2 females; Pushkin, on grass, August 23, 1958, 1 female, 1 male (E. Sugonyaev). Recorded as a parasite of spruce mealy bug in Bavaria (Ferrière, 1955). In spite of a larger collection it was not recorded on this mealy bug in the Leningrad region.

According to the structure of the antenna the females collected in the Leningrad region differ somewhat from those described by Ferrière; they had a greater resemblance to the type (Mercet, 1925).

## Genus PEZAPHYCUS NOV.

The only species of this genus, P. obenbergeri Nov., is described by Novickij (1926) from Czechoslovakia with no mention of the host. The genus Pezaphycus has much in common, particularly in the structure of the abdomen, with the genus Pseudaphycus Claus., differing from the latter principally in the 6-jointed funicle of the antenna, the small ocelli and the structure of the thorax. The flattened, elongated body and the loss of wings appear to be adaptive features permitting the parasite to enter the crevices in the soil where it pursues its prey–the lucerne mealy bug (Pseudococcus multivorus Kir.) living on the root-necks and roots of lucerne and other plants.

### 2. Pezaphycus obenbergeri Nov. (Figs. 75-79)

Female. Head large, a little wider than long in front. Frons and vertex somewhat less than twice as long as broad. Ocelli very small, arranged in the form of an equilateral triangle (60°). Scape of antenna somewhat spindle-shaped, almost four times as long as wide, the pedicel being as long as the four following joints of the funicle. All joints of the funicle transverse, the first joint rather more than 1.5 times as wide as long. Club tapered at the tip, longer than the funicle. Maxillary palp 3-jointed, labial palp 2-jointed. Mandible 3-toothed, middle tooth projecting. Thorax trapezoidal, almost 1.5 times as wide at the base as at the tip. Pronotum wide, scutum of mesonotum twice as wide as long, scutellum transverse. Mesonotum and postphragma very small. Flank of mesothorax large. Wings rudimentary. Spur of middle tibia smaller than the first joint of the middle tarsus, the latter a little longer than the two following joints. Abdomen somewhat longer than the thorax. The ninth syntergite transverse, lateral lobes reduced. Outer valve of ovipositor elongated, almost five times longer than the greatest width, the terminal edge bent upwards. Apodemes long and narrow, coinciding with the inner edge of the valve. Base of the ovipositor reaches the first (visible) abdominal segment, the protruding part of it being equal to $^1/_3$ the length of the abdomen. Seventh sternite reaches the end of the abdomen and looks like the seventh sternite in Pseudaphycus austriacus Merc. Body yellowish, abdomen somewhat darkened. Antenna darkened, the club whitish. Length 0.9 mm.

Male looks like the female; it differs in the unsegmented club of the antenna.

Ukraine: Poltava, from Pseudococcus multivorus Kir., August 31, 1939, four females, one male (Keleberdina).

Our specimens are rather different from those described by Novitsk in having the basal joints of the funicle of the antennae less transverse. A winged form of this species is described by Hoffer (1954).

### 3. Aphycus (Aphycaspis) sp. (Figs. 16-21)

Female. Frons quite wide. Scape of antenna slightly dilated in the middle, almost 4-5 times as long as its greatest width. Pedicel rather more than three times shorter than the scape, twice as long as its width at the tip, a little shorter than the three following joints of the funicle, taken together. Joints of funicle gradually increasing in size toward the tip, each one a little wider than the one preced-

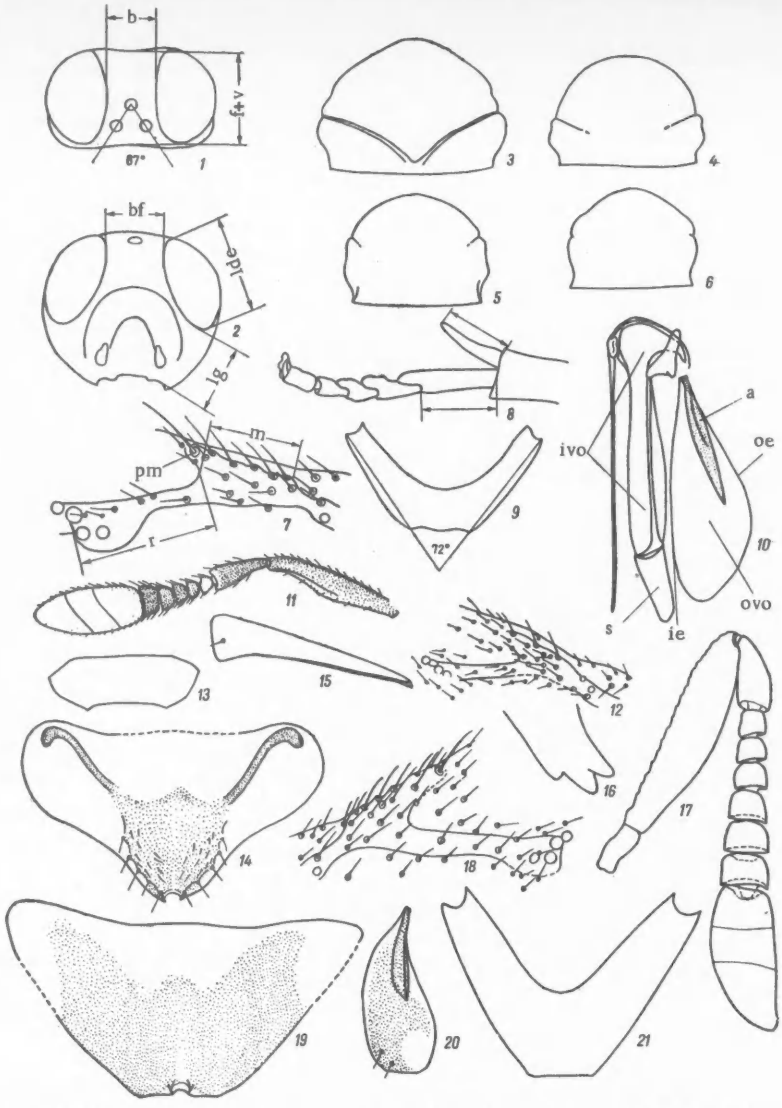
## Genus APHYCUS MAYR

1 (2). Joints of funicle similar in shape and gradually increasing in size toward the tip. Parapsidial grooves almost complete. Hairs on thorax always blackish. The 9th syntergite V-shaped with well-developed lateral lobes. Apodemes blade-like, diverging from the inner edge of the outer valve of the ovipositor. Marginal vein as long as wide, a little shorter than the post-marginal, the latter three times as short as the radial vein. Body yellowish, the first three segments of the abdomen white, the remainder brown. Ovipositor protrudes $^1/_5$ - $^1/_6$ the length of the abdomen (subgenus Aphycaspis Hffr.) . . . . . 3–Aphycus sp.

2 (2). Basal joints of funicle small, clearly transverse, 5th-6th joints, on the contrary, strongly developed. Parapsidial grooves almost absent, noticeable only in front. Hairs on the thorax always white. The 9th syntergite transverse with very short lateral lobes. Apodemes very narrow and coincide with the inner edge of the outer valve of the ovipositor. (Subgenus Aphycus s. str.).

3 (4). Fore-wings almost transparent. Body entirely yellow. Funicle darker than the remainder of the antenna . . . . . 4-A. sumavicus Hffr.

4 (3). Fore-wings with brown spot under the marginal vein. Head and thorax orange-yellow, abdomen brownish. Antennae light brown, the last joint of the funicle and the club being white . . . . . 5-A. apicalis (Dalm.)




Figs.1-21. 1,2-Metaphycus melanus sp. n. (1–head from above, 2–from the front) f+ v–length of frons and vertex, taken together, b–breadth, bf–breadth of frons, lde–longitudinal diameter of the eye, lg–length of gena); 3) Metaphycus Zebratus Merc. scutum of mesonotum with complete parapsidial grooves; 4) M. melanus sp. n. scutum with clearly-marked traces of parapsidial grooves; 5) Aphycus apicalis (Dalm.), parapsidial grooves absent, only slightly marked in front; 6) Euaphycus salicis (Erd.), scutum entirely without parapsidial grooves; 7) Anaphycus nitens (Kurd.), venation of fore-wing ( m–marginal vein, r–radial vein, pm–post-marginal vein); 8) Mesaphycus picearum (Erd.) size of spur of tibia of fore-leg and 1st joint of middle tarsus; 9) Metaphycus melanus, sp. n. angle formed by the lateral edges of the lobes of the 9th syntergite; 10) M. punctipes (Dalm.), parts of the ovipositor (ovo–outer valve of ovipositor, oe–outer edge, ie–inner edge, a–apodeme, ivo–inner valve of ovipositor, s–sheath of ovipositor); 11-15) Pseudaphycus austraicus Merc., female (11–antenna, 12–venation of fore-wing, 13–9th abdominal syntergite, 14–7th abdominal sternite, 15–outer valve of ovipositor); 16-21) Aphycus (Aphycaspis) sp. female (16–mandible, 17–antenna, 18–venation of fore-wing, 19–7th abdominal sternite, 20–outer valve of ovipositor, 21–9th abdominal syntergite).

ing it. The first three joints of the funicle equal in length, clearly shorter than the three at the distal end, also approximately equal in length. The 6th joint of the funicle 1.5 times as broad as long and 1.7-1.8 times as wide as the first joint of the funicle. Club tapering, wider than the funicle, almost as long as the five preceding joints of the funicle, taken together. Mandible with three teeth, the middle one rather protruding. Maxillary palp 4-jointed, labial palp 3-jointed. Scutum of mesonotum with almost complete parapsidial grooves, thickly trimmed with brown hairs. Scutellum quite thickly covered in the upper angles and with sparse hairs at the tip and bare, longitudinal stripes in the middle part. Wings thickly covered with minute hairs; a bare, oblique, stripe extends beneath and is interrupted on the lower edge by two to three rows of hairs. Marginal vein short, almost as long as wide, a little shorter than the washed-out, post-marginal vein beneath it, the latter three times as short as the radial vein. Spur of middle tibia shorter than the first joint of the middle tarsus, the latter clearly five times as long as wide and equal in length to the three following joints, taken together. Length and breadth of the abdomen approximately equal to those of the thorax. The 9th abdominal syntergite somewhat V-shaped, the well-developed lateral lobes converging at an angle of approximately 60°. Outer valves of ovipositor wide, curved, rather more than twice as long as broad with two hairs at the tip. Apodemes leaf-like, diverging from the inner edge of the valve of the ovipositor. Sheaths of ovipositor long and narrow, about 1.5 times as short as the inner valve of the ovipositor. The 7th sternite triangular, nearly V-shaped, somewhat truncated at the end (Fig. 19). Base of ovipositor reaches the anterior edge of the 6th abdominal sternite, the protruding part of the ovipositor equal to $\frac{1}{5}$ to $\frac{1}{6}$ the length of the abdomen. Head yellowish, frons and vertex orange-yellow, occiput darkened. Scape of antenna dirty-yellow with a brown stripe along the upper edge and in the distal half along the lower edge. Pedicel and 1st-5th joints of the funicle brown, 6th joint and the club white. Pronotum yellow with a brown spot in the middle scutum of mesonotum dirty-yellow, darkened in front, axillae and scutellum dirty-yellow, sutures between scutum, axillae and scutellum and the edge of the scutellum darkened. Tegulae white, brown at the tip. Metanotum and the intermediate segment brown, flank of mesothorax reddish, darkened. Wings transparent with a small brown spot under the marginal vein. Legs white, the anterior and middle tibia rather darkened, hind tibia brownish, dirty-white at the tips. Anterior tarsi completely darkened, also the last joint of the middle and posterior tarsi. Abdomen bicolored: the first three abdominal segments white and translucent, the remainder brown. Ovipositor light yellow. Length 1.2 mm.

Male, not known.

Leningrad region: Pushkin; species caught on spruce infested by the spruce mealy bug, July 30, 1958, 1 female (E. Sugonyaev).

It differs from the related A. šnoflaki Hffr. (Hoffer, 1954) in the following characters:

Aphycus sp.

1. Body yellowish with brown, head orange-yellow.
2. Legs white, tibia more or less darkened.
3. First three abdominal segments white, the remainder brown.
4. Scape of antenna dirty-yellow, pedicel and 1st-5th joints of funicle brown, 6th joint and club white.
5. Radial vein almost twice as long as the post-marginal vein.

A. šnoflaki Hffr.

1. Body brown, face a little lighter.
2. Legs brown.
3. First abdominal segment white, remainder blackish-brown.
4. Antennae brown, 5th-6th joints of funicle and the club yellowish-red.
5. Radial vein three times as long as the post-marginal vein.

### 4. Aphycus (in sp.) sumavicus Hffr. (Figs. 22-25)

Female. Frons approximately as broad as the eye. Ocelli arranged in an almost right-angled triangle (92°). Scape of antenna 6.5 times as long as broad. Marginal vein almost as long as the post-marginal, the latter approximately twice as short as the radial. Spur of middle tibia shorter than the first joint of the middle tarsus. Abdomen shorter than the thorax. Ovipositor protrudes $\frac{1}{2}$ to $\frac{1}{3}$ the length of the abdomen. Outer valve of the ovipositor four times as long as wide. The 7th sternite typically V-shaped. Head yellow. Scape and pedicel of antenna reddish, the joints of the funicle reddish-brown, the club yellowish-white with the basal half darkened. Thorax brick-yellow. Legs yellow, the anterior tarsus darkened, the last joints of the middle and hind tarsi brownish. Length 1.2 mm.

Male differs from the female in the unsegmented club of the antenna and in the abdomen which is not shorter than the thorax. Length 1.1 mm.

Leningrad region: an islet in the Ladozhskoye lake, 35-40 km northwest of Priozersk, from spruce mealy bug (Paroudablis piceae Loew.), May 31, 1957, 2 females, 1 male (E. Sugonyaev); Pushkin, caught on spruce July 30, 1958, 3 females (E. Sugonyaev).

Our specimens rather differ from those described by Hoffer in the smaller size of the ocelli and the less transverse joints of the funicle.

The species is described by Hoffer (1954) from Czechoslovakia with no reference to the host.

### 5. Aphycus (in sp.) apicalis (Dalm.) (Figs. 5, 26-29)

Female. Frons and vertex rather less than three times as long as wide, ocelli arranged in an acute-angled tri-

angle (52°). Frons narrower than the eye. Gena scarcely shorter than the longitudinal diameter of the eye. Scape of antenna long, longer than the funicle and the pedicel, taken together. First joints of funicle twice as wide as long, the 6th joint 1.5 times as wide as long. Club as long as the five preceding joints of the funicle, taken together. Scutum of mesonotum slightly transverse, scutellum almost as long as the scutum. Pronotum with light hairs. Spur of middle tibia clearly shorter than the first joint of the middle tarsus. Length 0.8-1.2 mm.

Widely distributed in the European parts of USSR. A parasite of the maple mealy bug (Phenacoccus aceris Geoffr.). Information on the biology and economic importance of the parasite was given earlier (Sugonyaev, 1958).

Genus Mesaphycus Sugonyaev, gen. n. (Figs. 30-33)

Female. Frons approximately as wide as the eye. Antenna of dissimilar colors, inserted a little above the edge of the mouth. Scape of antenna long, linear. Club 3-segmented, a little wider than the funicle, shorter than the others. Seventh sternite reaches the end of the abdomen but is not V-shaped as in Aphycus, but has a short rounded apex (Fig. 33). Sheaths of ovipositor (3rd valve according to Domenichini, 1953) short and wide. Apodemes of outer valves of ovipositor narrow, diverging from the inner edge of the valve; upper part of the valve curves upwards a little. Ninth syntergite bent in the form of a half moon with long lateral lobes. Ovipositor projects slightly.

Type for genus: Aphycus picearum Erdos.

Genus Mesaphycus, gen. n., is isolated on the basis of the following characteristics discriminating it from the related genera Aphycus and Metaphycus (female).

Mesaphycus, gen. n.

1. Mandible 3-toothed, middle tooth not longer than the others.
2. Ovipositor slightly projects, sheath of ovipositor approximately four times shorter than the inner valve of the ovipositor.
3. Seventh abdominal sternite broadly rounded at the tip.
4. Apodemes of the outer valve of ovipositor diverge from the inner edge of the latter.

Aphycus Mayr, s. str.

1. Mandible 3-toothed with long middle tooth.
2. Ovipositor protrudes to $\frac{1}{2}$ to $\frac{1}{3}$ the length of the abdomen, sheaths of the ovipositor 1.5 - 2 times shorter than the inner valve of the ovipositor.
3. Seventh sternite V-shaped.
4. Apodemes of the outer valve of the ovipositor curved, coinciding with the inner edge of the latter (Fig. 27).

Mesaphycus, gen. n.

1. Mandible 3-toothed, middle tooth not longer than the others.
2. Sheath of the ovipositor approximately 1.5 - 2 times shorter than the inner valve of the ovipositor.
3. Outer valve of the ovipositor comparatively narrow, somewhat triangular in shape; apodemes narrow.
4. Club of antenna black, wings transparent.

Mesaphycus, gen. n.

1. Scape of antenna linear.
2. Seventh sternite reaches the end of the abdomen.
3. Apodemes narrow, somewhat sword-shaped.

sg. Aphycaspis Hffr.

1. Mandible 2-toothed, middle tooth projecting.
2. Sheath of ovipositor 1.5 times as short as the inner valve of the ovipositor.
3. Outer valve of ovipositor wider, curved at the tip; apodemes leaflike.
4. Club of the antenna white, wings with brown spot under the marginal vein.

Metaphycus Merc.

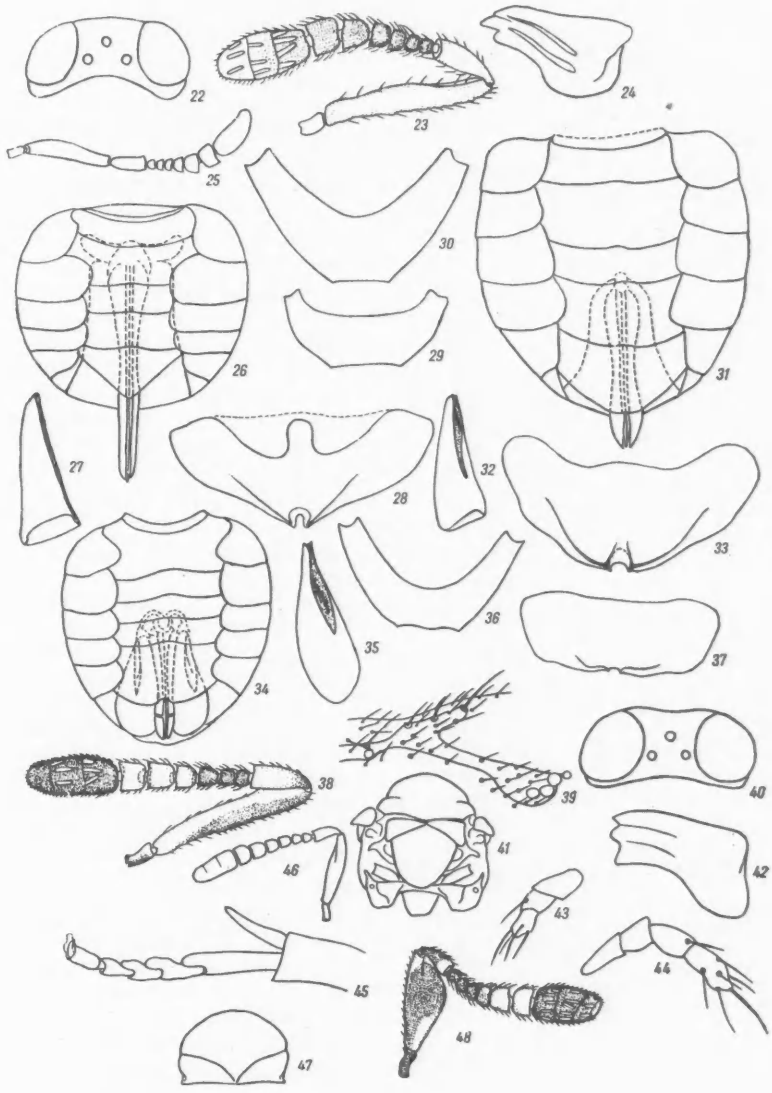
1. Scape of antenna expanded and depressed.
2. Seventh sternite does not reach the end of the abdomen.
3. Apodemes leaf-like.

As is seen from the comparisons, Mesaphycus gen. n. occupies an intermediate position between Aphycus and Metaphycus. According to the structure of the 7th abdominal sternite M. picearum is related to the genus, the species of which parasitize mealy bugs (Pseudococcidae) (Compere, 1947).

6. Mesaphycus picearum (Erd.), comb. n. (Figs. 30-33, 38-46).

Female. Frons and vertex a little longer than wide, with white hairs. Scape of antenna six times as long as wide. All joints of the funicle almost as long as wide. Thorax longer than wide (21:15). Scutum of mesonotum twice as wide as long with well-marked traces of parapsidial grooves (Fig. 41) with white hairs. Abdomen approximately as long as the thorax, longer than wide. Angle between the posterior edges of the lateral lobes of the 9th syntergite about 75°. Outer valve of ovipositor in the middle 2.5 times as long as its greatest width. Ovipositor projects to $\frac{1}{8}$ to $\frac{1}{9}$ the length of the abdomen. Head light yellow, gena and base of the face whitish, occiput with blackish spot. Eyes black, ocelli reddish-brown. Scape of antenna yellowish with a brown stripe along the upper edge, pedicel yellowish, brownish at the base, the first four joints of the funicle brownish, 5th-6th yellowish, club black. Thorax yellow, darkened here and there. Wings transparent. Legs yellow. Abdomen yellow, slightly darkened on top. Length 1.2-1.3 mm.

The male is described for the first time; it differs from the female in the more depressed scape of the antenna, the club not wider than the last joints or a little wider with weakly-marked segmentation. Scape of antenna yellow




Figs. 22-48. 22-25) Aphycus sumavicus Hffr. (22–head from above, 23–antenna, 24–mandible of female, 25–antenna of male); 26-29) A. apicalis (Dalm.) female (26–abdomen from below, 27–outer valve of ovipositor, 28–7th sternite and 29–9th syntergite of abdomen); 30-33, 38-46) Mesaphycus picearum (Erd.) (30–9th syntergite, 31–abdomen from below, 32–outer valve of ovipositor, 33–7th sternite, 38–antenna, 39–venation, 40–head from above, 41–thorax, 42–mandible, 43–maxillary and 44–labial palp, 45–end of the middle tibia and tarsus of female, 46–antenna of male); 34-37) Metaphycus insidiosus Merc. (34–abdomen from below, 35–outer valve of ovipositor, 36–9th syntergite, 37–7th sternite of female); 47,48) Metaphycus zebratus Merc. (47–scutum of mesonotum and 48–antenna of female).

with a brown stripe on the distal half of the upper edge, pedicel yellow, funicle and club brownish. Length 1.2 mm.

Leningrad region: Pushkin, from larvae of 2nd instar Physokermes hemicriphus (Dalm0), July 22, 1955, 1 female, July 9-14, 1956, 1 female, 1 male; Lomonosov, from 2nd instar larvae of Ph. hemicriphus, July 25, 1956, 1 female; Zelenogorsk, from 2nd instar larvae of Ph. picae (Schr.) and Ph. hemicriphus, July 9-August 3, 1956, 4 females, 3 males; Luga, from 2nd instar larvae of Ph. hemicriphus, July 14, 1956, 1 female, August 3, 1956, 1 female (Sugonyaev).

The species is described in the genus Aphycus Mayr (Erdös, 1955) with no mention of the host.

## Genus Anaphycus Sugonyaev, gen. n. (Figs. 7, 66-74)

Female. Frons and vertex narrow. Scape of antenna slightly expanded, almost spindle-shaped, club as long as, or a little shorter than the funicle, 3-segmented. Mandible with three teeth, middle one not protruding, maxillary and labial palps 3-jointed. Scutum of mesonotum with decided traces of parapsidial grooves. Marginal vein comparatively well developed, approximately 1.5 times shorter than the radial. Wings transparent. The 9th abdominal syntergite wide, lateral lobes markedly shortened. Outer valve of ovipositor with a decided comb along the inner edge. The 7th abdominal sternite narrow, somewhat curved. Body entirely black. Scape of antenna of male not noticeably expanded, club unsegmented, transversely truncated at the tip. Antennae entirely brown.

Similar to Metaphycus Merc. In the general plan of structure of the abdomen. It differs in the very weakly expanded, almost spindle-shaped, scape of the antenna, the large club as long as or a little shorter than the funicle, the comparatively well-developed marginal vein, the general color of the body, the wider 9th abdominal syntergite, the lateral lobes of which are markedly shortened (Fig. 69), the presence of a decided comb along the inner edge of the outer valve of the ovipositor and the narrower 7th abdominal sternite.

Anaphycus nitens (Kurd.) parasitizes scale insects of the subfamily Eriococcinae, whereas the species of the genus Metaphycus, as a rule, parasitize the Coccidae.

Type for the genus: Aphycus nitens Kurdjumov.

## 7. Anaphycus nitens (Kurd.), comb. n.

Female. Frons and vertex almost 2.5 times as long as wide. Eyes large. Ocelli arranged in the form of an acute-angled triangle, the distance between the posterior ocelli a little more than that from the ocellus to the eye orbit. Antennae short, scape four times as long as wide. Joints of funicle transverse, the 6th almost twice as wide as long. Club elongated-oval, its length equal to or a little shorter than that of the funicle. Thorax longer than wide (43:35). Marginal vein approximately 1.5 times as short as the radial. Spur of middle tibia a little longer or equal to the first joint of the middle tarsus. Abdomen longer and a little wider than the thorax. Posterior edges of the 9th syntergite form an angle of about 50°. Outer valve of the ovipositor approximately 2.5 times as long as broad with a conspicuous comb along the inner edge. Ovipositor slightly protruding. Head and thorax clothed in whitish hairs. Body entirely black with a slight oily gloss except the tegulae which are whitish. Scape of antenna brownish, blackish beneath, pedicel brownish at the base and yellow at the tip, 1st - 4th joints of funicle brownish, 5th-6th dirty-yellow, club blackish, dirty-yellow at the tip. Legs yellow, middle and hind coaxae darkened at the base, hind femora blackish in the middle. All tarsi rather darkened. Ovipositor brown. Length 1.2 mm.

The male differs from the female in the following characters: scape of antenna hardly dilated, club unsegmented, antennae entirely brown, legs brown, the knee, tips of middle and hind tibia brownish-yellow, tarsi yellowish brown, the last joint blackish, fore-wing with a brown spot under the marginal vein, hind-wing with a brown spot at the base. Length 0.8 mm.

The female, described by Kurdjumov (1912), differs from ours in the dark brown antennae, the darker colored legs and the non-projecting ovipositor.

Ukraine: Poltava experimental station, from Eriococcus greeni Newst. (H. Kurdjumov). Leningrad region: Luga, on the scale insect Rhizococcus insignis (Newst.), collected on Calamagrostis sp., August 6, 1956, 1 female, 1 male; Pushkin, from scale insects of the subfamily Eriococcinae, July 22, 1957, 1 female (E. Sugonyaev).

The holotype, evidently, is lost; the identity of our specimens with those described by Kurdjumov is established according to the original description.

## 8. Metaphycus Zebratus Merc. (Figs. 3, 47, 48)

Frons and vertex narrow, almost three times as long as wide. Ocelli arranged in the form of an acute-angled triangle, the distance from the posterior ocellus to the anterior ocellus and to the edge of the occiput approximately equal. Gena equal to or a little longer than the transverse diameter and almost twice as short as the longitudinal diameter of the eye. Scape of antenna almost twice as long as wide, all the joints of the funicle transverse, the 6th being 1.6-1.7 times as wide as long. Club of antenna as long as the four preceding joints of the funicle, taken together. Scutum of mesonotum with distinct, complete parapsidial grooves. Spur of middle tibia equal to the first joint of the middle tarsus, the latter equal in length to the three last joints. Ovipositor does not project. Similar in color to M. punctipes (Dalm.). Length 1.0-1.2 mm.

The male differs from the female in the lemon-colored mesonotum and the uniformly brown color of the antennae. Length 0.7 mm.

Ukraine: Chernigovsk region, Bobrovits station from the coccid Eriopeltis lichtensteini Sign., July 14-22, 1949, massed material (P. Dyadechko). The species is mentioned in the work of Dyadechko (1950) under the name

1 (6). Ovipositor does not project. Sixth joint of the funicle more than 1.5 times as wide as long.
2 (3). Frons and vertex almost three times as long as wide. Ocelli arranged in the form of an acute-angled triangle. Scape of antenna almost 2.5 times longer than wide. Scutum of mesonotum with distinct, complete parapsidial grooves . . . . . 8. M. zebratus Merc.
3 (2). Frons and vertex less than twice as long as wide. Ocelli arranged in the form of an equilateral or a moderately acute-angled triangle.
4 (5). Scape of antenna 2.6-2.7 times as long as wide. Spur of middle tibia shorter than the first joint of the middle tarsus. Ocelli arranged in the form of a moderately acute-angled triangle (80°). Thorax black above. Antennae of the male club-shaped . . . . . 9. M. phaeus (Erd.)
5 (4). Scape of antenna twice as long as wide. Spur of middle tibia almost as long as the first joint of the middle tarsus. Ocelli arranged in the form of an equilateral triangle (64°). Thorax yellowish, red above. Antennae of male elongated and look like those of the female . . . . . 10. M. punctipes (Dalm.)
6 (1). Ovipositor clearly protrudes. Sixth joint of funicle much more than 1.5 times as wide as long.
7 (8). Frons and vertex twice as long as wide. Ocelli arranged in the form of an acute-angled triangle (40°). First and 2nd joints of funicle round, the remainder distinctly transverse, 6th joint 1.5 times as wide as long. Maxillary palp 3-jointed. Head and thorax yellowish-red. Antennae of male club-shaped, brown . . . . . 11. M. insidiosus Merc.
8 (7). Frons and vertex less than twice as long as broad. Ocelli arranged in the form of an equilateral triangle (67°). Fifth joint of funicle quadrate, 6th joint a little wider than long. Head whitish-yellow, thorax blackish above. Antenna of male filiform . . . . . 12. M. melanus, sp. n.

Encyrtus hyalipennis Mayr. (according to the identification of I. D. Belanovsk).

### 9. Metaphycus phaeus (Erd.), comb. n. (Figs. 49-51)

Female. Gena almost 1.5 times shorter than the longitudinal diameter of the eye. Scape of antenna 2.6-2.7 times as long as broad. Thorax longer than wide. Scutum of mesonotum approximately twice as wide as long. Abdomen round, shorter than the thorax, almost as wide as long. Head white, vertex with transverse black spot not reaching the anterior ocellus, occiput black. Thorax black above, side of scutum, scutellum on the upper edge, tegulae, with the exception of the tips, middle of mesonotum and side of the intermediate segment whitish. Flank of mesothorax white, darkened on the lower edge. Legs black with dark spots and rings. Abdomen black above, whitish at the edge. Length 1.5 mm.

The male is not found in USSR. According to Erdös (1955) it differs from the female in the lesser dilation of the scape of the antenna, 5th and 6th joints of the funicle well-developed in contrast to the first four, club of antenna short oval-shaped and approximately equal in length to the three preceding joints of the funicle. Antennae almost uniformly colored, of a dirty-black hue, middle of scape of antenna and base of pedicel brownish. Length 0.6-0.7 mm.

The female differs rather from that described by Erdös in the arrangement of the ocelli and in the length of the gena.

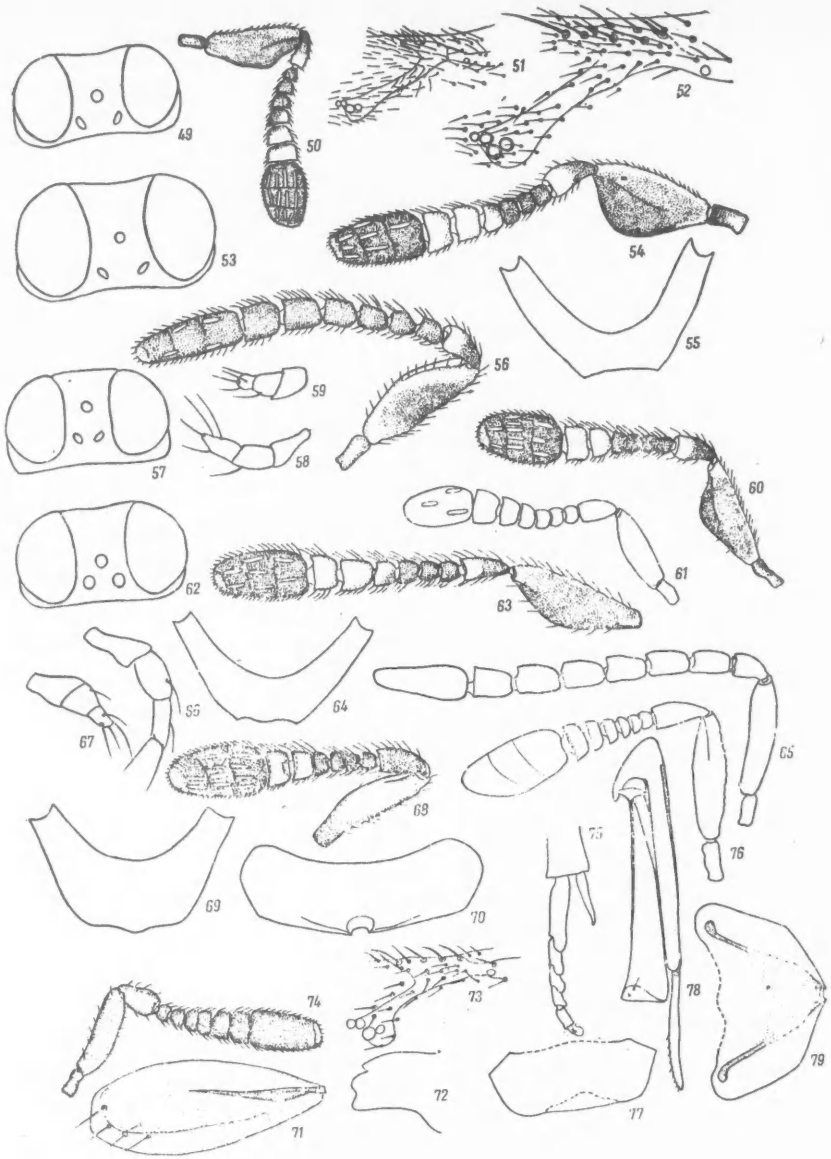
Leningrad: Zayachii island from birch coccid (Pulvinaria betulae L.) May 22, 1956, 1 female (E. Sugonyaev); Moscow: from birch coccid, August 13, 1957, 1 female (E. Drozdovskii).

M. phaeus is described in the genus Aphycus Mayr. without reference to the host.

### 10. Metaphycus punctipes (Dalm.) (Figs. 10, 52-56).

Female. Frons and vertex less than twice as long as broad. Ocelli arranged in the form of an equilateral triangle (64°). Gena somewhat more than 1.5 times as short as the longitudinal diameter of the eye. Distance between the antennal pits almost as wide as the width of the frons. Scutum of mesonotum approximately twice as wide as long. Scutellum a little longer than wide. Spur of middle tibia equal to the first joint of the middle tarsus. Posterior edges of the lateral lobes of the 9th syntergite form an acute angle (60°). Outer valve of ovipositor quite wide, 2-2.5 times as long as wide. Ovipositor concealed or slightly protruding. Head and notum yellowish-red, sutures of mesonotum and shoulders slightly darkened. Metanotum and the intermediate segment dark brown, the latter with whitish spots at the side. Side of mesothorax whitish. Legs white with dark brown rings and spots. Abdomen blackish above. The 9th syntergite light, translucent with brown border to the posterior edge, expanding to the middle of the tergite. Basal half of valves of the ovipositor brown, tips light, translucent. Length 1.1-1.45 mm.

The male differs from the female in the thinner and longer antennae. The scape is almost three times as long as broad, pedicel somewhat more than 1.5 times longer than the first joint of the funicle. The 1st - 5th joints of the funicle longer than wide, 6th quadrate. Club hardly wider than the last joint of the funicle with weakly marked segmentation, as long as the three preceding joints of the funicle, taken together, rounded at the tip. Scape of an-



Figs. 49-79. 49-51) Metaphycus phaesus (Erd.)(49–head from above, 50–antenna and 51–venation of female); 52-56) M. punctipes (Dalm.) (52–venation, 53–head from above, 54–antenna and 55–9th syntergite of female, 56–antenna of male) 57–61); M. insidious Merc. (57–head from above, 58–maxillary and 59–labial palp, 60–antenna of female, 61–antenna of male); 62-65) M. melanus, sp. n. (62–head from above, 63–antenna, 64–9th syntergite of female, 65–antenna of male); 66-74) Anaphycus nitens (Kurd.) (66–maxillary and 67–labial palp, 68–antenna, 69–9th syntergite, 70–7th sternite, 71–outer valve of ovipositor, 72–mandible of female, 73–venation of fore-wing and 74–antenna of male); 75-79) Pezaphycus obenbergeri Nov. (75–end of middle tibia and tarsus, 76–antenna, 77–9th syntergite, 78–outer and inner valves and sheaths of ovipositor, 79–7th abdominal sternite of female).

tenna whitish with a brown spot in the center near the upper edge, pedicel brown at the base and whitish at the tip, funicle and club brownish. Length 0.8 mm.

Crimea: Simferapol, from plum coccid (Sphaerolecanium prumastri Fonsc.) the summer of 1950, 4 females, 2 males (E. Khersonskaya).

The species was identified by M. N. Nikol'skii. It was re-identified by the author from the descriptions of Nees (1834), Mayr (1876), Thomson (1878), Silvestri (1919) and Mercet (1921). Mayr and Thomson, familiar with the type, identify the male of M. punctipes by the comparatively short antennae. According to Mayr, the pedicel of the antenna of the male is longer than the first joint of the funicle and is rounded at the end, that is, the antenna is rather like that of the female.

In our opinion, the description of the male M. punctipes, followed by Silvestri and accepted by Mercet, is not correct. Since Silvestri considered the species M. punctipes to be widely spread, so the idea cannot be excluded that the male described by him with filiform antennae belonged to a different species. Among the species of the genus introduced into the fauna of the European parts of USSR only the male of the species M. melanus, sp. n. has filiform antennae.

### 11. Metaphycus insidiosus Merc. (Figs. 34-37, 57-61).

Female. Gena approximately 1.5 times as short as the longitudinal diameter of the eye. Scape of antenna 2.5 times as long as its breadth in the middle. Posterior edges of the lateral lobes of the 9th syntergite form an acute angle (about 60°). Outer valve of ovipositor quite translucent on the edge, almost three times as long as wide. Ovipositor protrudes slightly. Coloring similiar to that of M. punctipes. The female is characterized by the presence of two brown triangular spots behind the posterior ocellus. Length 0.7-1.2 mm.

The male differs from the female in the unsegmented club of the antenna, the scape being three times as long as wide, dirty-white at the base and brownish-yellow at the tip with a brown spot in the central part. Funicle and club brown. Length 0.6-0.8 mm.

The species is widely distributed in all European parts of USSR and is represented in the collection of the Zoological Institute AN USSR, but in consequence of the external similarity it was identified earlier as M. punctipes (Dalm.), or M. parvus Merc.

The species differ according to the following characteristics (female):

M. insidiosus Merc.

1. Frons and vertex clearly twice as long as wide, ocelli arranged in the form of an acute-angled triangle.
2. Scape of antenna 2.5 times as long as wide.
3. Maxillary and labial palps 3-jointed.

M. punctipes (Dalm.)

1. Frons and vertex less than twice as long as wide, ocelli arranged in the form of an equilateral triangle.
2. Scape of antenna twice as long as wide.
3. Maxillary palp 4-jointed, labial palp 3-jointed.

It infests the acacia coccid (Parthenolecanium corni Bche.), which, evidently, appears to be its chief host.

The biology and economic importance of the parasite were described earlier (Sugonyaev, 1958).

### 12. Metaphycus melanus Sugonjaev, sp. n. (Figs. 1, 2, 4, 62-65)

Female. Head as wide as the thorax. Ocelli arranged in the form of an almost equilateral triangle (68°). Frons and vertex almost twice as long as wide with whitish hairs. Scape of antenna somewhat less than three times as long as wide. Pedicel distinctly shorter than the three succeeding segments of the funicle, taken together. The 5th joint of funicle almost quadrate, 6th a little wider than long. Length of club equal to 3.5 of the preceding joints of the funicle. Maxillary palps 4-jointed, labial palps 3-jointed. Mandibles with three small teeth. Thorax longer than wide (48:40). Scutum of mesonotum 1.5 times as wide as long with distinct traces of parapsidial grooves. Marginal vein very short, radial vein quite long. Spur of middle tibia equal to the first joint of the middle tarsus, the latter shorter than the three succeeding joints. Abdomen short-oval in shape, a little wider than the thorax and as long as the thorax. Posterior edges of the lateral lobes of the 9th syntergite form an acute angle (70°). Outer valve of ovipositor approximately three times as long as wide. Ovipositor protrudes slightly. Head whitish-yellow, the remaining color as in M. phaeus, only rather lighter. Length 1.1-1.2 mm.

The male differs from the female in the long, filiform antennae. Head hemispherical. Scape of antenna slightly expanded, pedicel shorter than the first joint of the funicle and 1.5 times longer than wide at the tip. Club rather longer than the two preceding joints of the funicle. Length and breadth of the abdomen approximately equal to those of the thorax. Scape of antenna dirty-white with brown spots on the upper edge. Basal half of pedicel blackish, the tip white. Funicle and club brown. A black triangular spot on the vertex reaches the anterior ocellus. Length 1.1 mm.

Leningrad region: Zelenogorsk, from 2nd instar male larvae of Physokermes piceae, July 9, 1956, 4 females (including the holotype), 1 male, July 11, 1956, 2 females (E. Sugonyaev); Leningrad, from 2nd instar larvae of Parthenolecanium corni (Bche.), July 7, 1956, 2 females, 3 males, including the allotype (B. Tryapetsyn); Sosnovka district, in the forest on male larvae of coccids on willow, July 20-30, 1954, 7 females, 4 males (T. Bushchik).

M. melanus, sp. n. looks like M. phaeus (Erd.), from which it differs in the less transverse joints of the funicle of the antenna in the female and the filiform antenna of the male.

## Genus EUAPHYCUS Merc.

According to the opinion of a number of authors (Compere, 1940; Hoffer, 1954), the genus Euaphycus should be

1. (2). Light yellow, head with clear, black rings. Scape of antenna a little more than three times as long as wide. . . . . 13. E. asterolecanii Merc.
2. (1) Head light yellow, thorax and abdomen brown to blackish above. Scape of antenna rather less than three times as long as broad . . . . . 14. E. salicis (Erd.)

considered as a synonym for the genus Metaphycus; nevertheless, it is admitted by Ferrière (1953) and Alam (1957), the latter of whom describes a number of supplementary characters which specify this genus. In our opinion it is useful to keep the genus Euaphycus since the species of this genus possess a number of features often not met with in species of the genus Metaphycus. The genus Euaphycus is characterized by the following basic characteristics: the club is as long as the funicle, the maxillary palps are 2-3 jointed, the labial palps always 2-jointed, the scutum of the mesonotum is entire, the apodemes of the outer valves of the ovipositor wide at the base and over the greater part of their area (Fig. 81).

### 13. Euaphycus asterolecanii Merc. (Figs. 88-90)

Female. Scape of antenna clearly expanded and depressed, rather more than three times as long as broad. Scutum of mesonotum entire, parapsidial grooves scarcely marked above. Spur of middle tibia a little longer than the first joint of the middle tarsus. Wings transparent. Body entirely light yellow, legs with black rings. Length 0.8 mm.

The male is not found in USSR. According to Mercet (1925) the male looks like the female. The pedicel of the antenna as long as the four succeeding joints of the funicle.

Leningrad region: Sestroretsk, from Asterolecanium quercicola (Bche.) on oak, July-August, 1956, 2 females (E. Sugonyaev).

### 14. Euaphycus salicis (Erd.), comb. n. (Figs. 80-87)

Female. Head a little wider than the thorax. Ocelli arranged in the form of an acute-angled triangle (50°). Scape of antenna considerably expanded and depressed, rather less than three times as long as wide. Joints of funicle transverse, the 6th twice as wide as long. Club almost as long as the funicle. Gena 1.5 times shorter than the longitudinal diameter of the eye. Thorax drawn out, scutum almost twice as wide as long, the parapsidial grooves scarcely evident in the middle. Spur of middle tibia as long as the first joint of the middle tarsus. Abdomen longer and wider than the thorax. Posterior edges of the lateral lobes of the 9th syntergite form an acute angle (about 50°). The outer valves of the ovipositor somewhat less than three times as long as wide, their apodemes with a wide base, blade-like. Ovipositor covered. Head whitish-yellow. Vertex with a white, transverse spot as far as its edge. Occiput brown, antennae black. The base and the tip of the scape, the tip of the pedicel, the 5th and 6th joints of the funicle and the end of the club more or less whitish. Thorax dark brown to blackish above, white on the side. Wings translucent. Legs whitish with brown rings. Abdomen blackish above. Length 1.2 mm.

The male, described for the first time, differs from the female in the lesser expansion of the scape of the antenna which is three times as long as wide; club with clearly marked segmentation. Antennae entirely brown, only the base and tip of the scape whitish. Length 1.0-1.1 mm.

Leningrad region: Sosnovka region, from male larvae of the willow coccid, August 20-30, 1954, 2 females, 3 males (T. Bushchik).

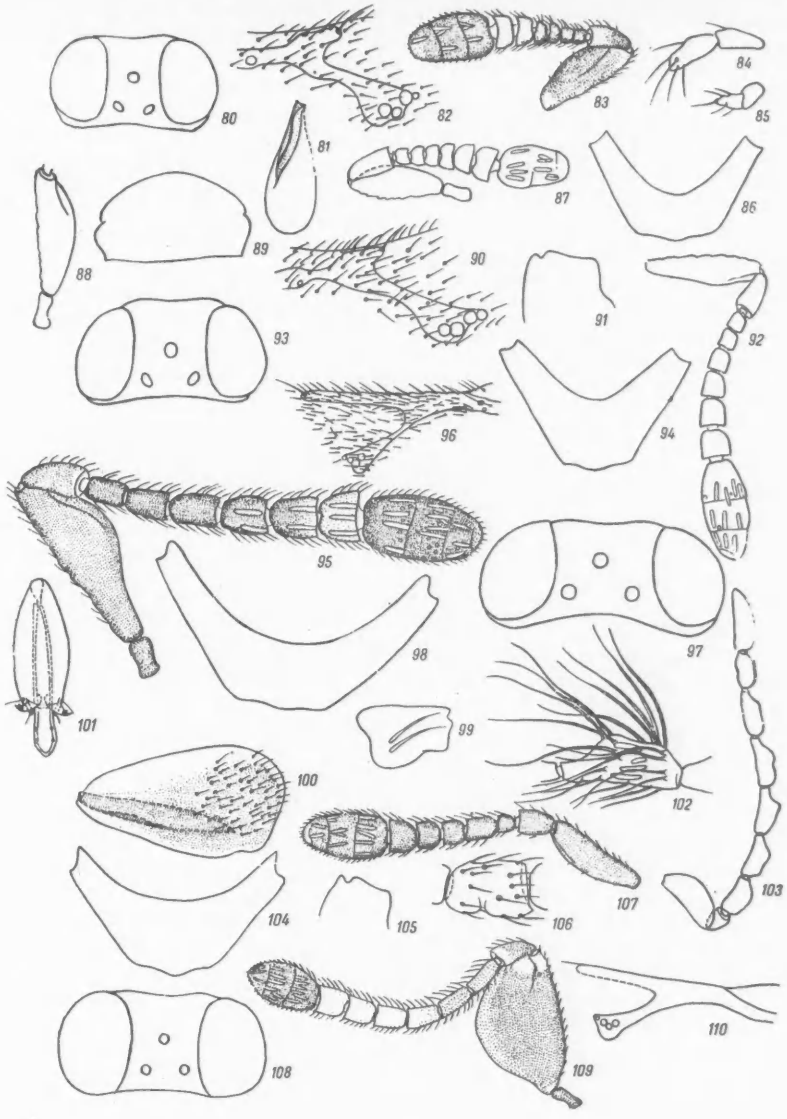
E. salicis is described by Erdös (1956) under the genus Metaphycus Merc. without mention of the host.

### 15. Blastothrix truncatipennis (Ferr.) (Figs. 91-94)

Female. Width of head equal to or a little wider than the thorax. Ocelli arranged in the form of a moderately acute-angled triangle (74°). Scape of antenna spindle-shaped, four times as long as wide. Pedicel hardly longer than the two succeeding joints of the funicle, taken together; 1st-4th joints of funicle a little longer than wide, 5th quadrate, 6th a little wider than long. Length of club equal to the four preceding joints of the funicle, taken together. Marginal vein scarcely longer than the post-marginal and radial, the latter equal in length. Posterior edges of lateral lobes of the 9th syntergite form an acute angle (60°). The

## Genus BLASTOTHRIX MAYR

1. (4). Scape of antenna slightly dilated, almost spindle-shaped.
2. (3). Scape of antenna four times as long as broad. Marginal vein scarcely longer than the radial and post-marginal veins, the latter equal in length . . . . . 15. B. truncatipennis (Ferr.)
3. (2). Scape of antenna 3.5 times as long as broad. Marginal vein longer than the post-marginal and shorter than the radial . . . . . 16. B. anomala, sp. n.
4. (1). Scape of antenna more or less expanded, much more than three times as long as wide.
5. (6). Scape of antenna approximately three times as long as wide. Pedicel shorter than the two succeeding joints of the funicle, taken together. . . . . 17. B. serica (Dalm.)
6. (5). Scape of antenna very strongly dilated, only a little longer than wide. Pedicel almost equal to the first joint of the funicle . . . . . 18. B. erythrostetha (Wlk.)




Figs. 80-110. 80-87) Euaphycus salicis (Erd.)(80–head from above, 81–outer valve of ovipositor, 82–venation, 83–antenna, 84–maxillary and 85–labial palp, 86–9th sternite of female, 87–antenna of male); 88-90) E. asterolecani Merc. (88–scape of antenna, 89–scutum of mesonotum, 90–venation of fore-wing of female); 91-94) Blastothrix truncatipennis (Ferr.) (91–mandible, 92–antenna, 93–head from above, 94–9th syntergite of female); 95-103) B. serica (Dalm.) (95–antenna, 96–venation of fore-wing, 97–head from above, 98–9th syntergite, 99–mandible, 100–outer valve of ovipositor, 101–genitalia, 102–3rd joint of funicle, 103–antenna of male); 104-107) B. anomala, sp. n. (104-9th syntergite, 105–mandible, 106–2nd joint of funicle, 107–antenna of female); 108-110) B. erythrostetha (Wlk.) (108–head from above, 109–antenna and 110–venation of fore-wing of female).

outer valves of the ovipositor clearly three times as long as wide. Ovipositor scarcely protrudes. Head blue-green. Antennae black, the base and tip of the pedicel, 5th joint of funicle partly, 6th joint entirely yellow. Scutum of mesonotum greenish-gold, axillae and scutellum darker with a coppery-red iridescence. Legs black with white and yellow, hind tibia black, base and distal third white. Abdomen violet. Length 1.1-1.5 mm.

The male differs in its filiform antennae with whorls of long hairs, the presence of paratergites, the golden-green head, scape of antenna white, pedicel blackish above, funicle and club black. Legs white, middle and hind coxae and hind femora brown or black. Length 1.1-1.3 mm.

Leningrad region: Zelenogorsk, from female of Eulecanium franconicum (Lndgr.) on bilberry (Vaccinium uliginosum L.), July, 14, 1956, 11 females, 4 males (E. Sugonyaev).

The species is described by Ferrière (1955) in the genus Microterys Thoms. Later Hoffer (1957) established its relation to the genus Blastothrix.

16. Blastothrix anomala Sugonyaev, sp. n. (Figs. 104-107)

Female. Frons wider than the eye. Ocelli arranged in the form of an almost right-angled triangle (86°). Gena a little shorter than the longitudinal diameter of the eye. Scape of antenna slightly expanded, approximately 3.5 times as long as wide. Funicle of antenna 5-jointed (possibly a malformation), the 2nd joint very long and formed by fusion of the 3rd and 2nd joints of the funicle (Figs. 106, 107), 4th - 5th joints of funicle clearly wider than long. Club rather longer than the three preceding joints of the funicle. Length of scutellum equal to that of the scutum of the mesonotum. Axillae scarcely touch. Spur of middle tibia longer than the first joint of the middle tarsus. Marginal vein a little longer than the post-marginal, shorter than the radial. Posterior edges of the lateral lobes of the 9th syntergite form an angle of 75°. Outer valves of ovipositor wide and short, twice as long as broad. Ovipositor scarcely protrudes. Frons and vertex dark bronze, face and gena green. Antennae entirely brown. Thorax dark bronze, tegulae whitish at the base and brown at the tip. Intermediate segment has a blue luster on the side. Wings transparent, veins brown. Legs dark brown, with slight blue or bronze luster, knee, tips of middle and hind tarsi light or yellowish-brown. Abdomen dark violet with a blue luster. Length 1.2 mm.

The male is not known.

Leningrad region: Luga on lime coccid (Eulecanium tiliae L.) July 24, 1957, 1 female holotype (E. Dantsig).

It differs from the related B. truncatipennis (Ferr.) in its rather shorter scape, more transverse distal joints of the funicle, the venation and the broader outer valve of the ovipositor.

17. Blastothrix serica (Dalm.) (Figs. 95-103)

Female. Frons and vertex almost as wide as long. Ocelli form an almost right-angled triangle (90-92°). Frons approximately 1.5 times as wide as the eye. Gena 1.5 times shorter than the longitudinal diameter of the eye. Scape of antenna approximately three times as long as wide. The 1st - 5th joints of the funicle more or less as long as wide, 6th joint a little wider than long. Club a little shorter than the three preceding segments of the funicle, taken together. Post-marginal vein of fore-wing 1.5 times as long as the marginal. Spur of middle tibia equal to the two following joints. Posterior edges of the lateral lobes of the 9th abdominal syntergite form a moderately acute angle (80°). Outer valve of ovipositor wide and short, almost twice as long as wide. Ovipositor does not protrude. Head golden-green, gena with blue iridescence. Pronotum, scutum, axillae and scutellum golden-green with silvery hairs. Wings transparent. Legs black, middle femora at the base, knee, and tips of all tibia light or whitish. All tarsi dark brown or blackish, the first joint of the middle tarsi white. Abdomen violet-colored, side and first and last abdominal segments golden-green. Length 1.6-1.9 mm.

The male differs from the female in its filiform antennae with whorls of long hairs, the funicle yellow and the distal half of the club brown. Legs white, darkened in places, middle tibia with two brown rings, hind femora black in the middle, the greater part of the hind tibia dark brown with two black rings. Fore-tarsi wholly, middle and hind tarsi partly, darkened. Length 1.0-1.9 mm.

Crimea: Yalta, from Parthenolecanium persicae F., June 8, 1931, 5 females (M. Nikol'skaya); Simferapol, 1950, 7 females, 4 males (E. Khersonskaya). Leningrad region: Luga, from females of Eulecanium tiliae L., July 24, 1957, 5 females, 6 males (E. Dantsig).

18. Blastothrix erythrostetha (Wlk.) (Figs. 108-110)

Female. Frons and vertex rather less than 1.5 times as long as wide. Ocelli arranged in the form of an equilaterial triangle (about 65°). Frons a little wider than the eye. Gena a little shorter than the longitudinal diameter of the eye. Scape of antenna dilated, leaf-like, 1.5 times as long as wide. Pedicel almost equal to the first joint of the funicle. The first and fifth joints of funicle longer than wide, 6th quadrate. Club oval, a little longer than the two preceding joints of the funicle. Marginal vein approximately equal to the radial and a little shorter than the post-marginal. Spur of middle tibia thick, equal to the first joint of the middle tarsus, the latter equal to the four succeeding joints. Outer valve of ovipositor broad and short, 1.5 times as long as wide. Posterior edges of the lateral lobes of the 9th syntergite form an acute angle (65-70°). Ovipositor protrudes slightly.

Vertex golden colored, frons green, gena and face blue, occiput blue-green. Scape of antenna black or dark brown, white at the tip, pedicel brown in the proximal half and whitish at the tip, funicle whitish, 1st-3rd joints darkened, club blackish. Pronotum, scutum and scutellum golden-green with recumbent silvery hairs, axillae bluish-green. Wings transparent with dark hairs in the upper half. Legs

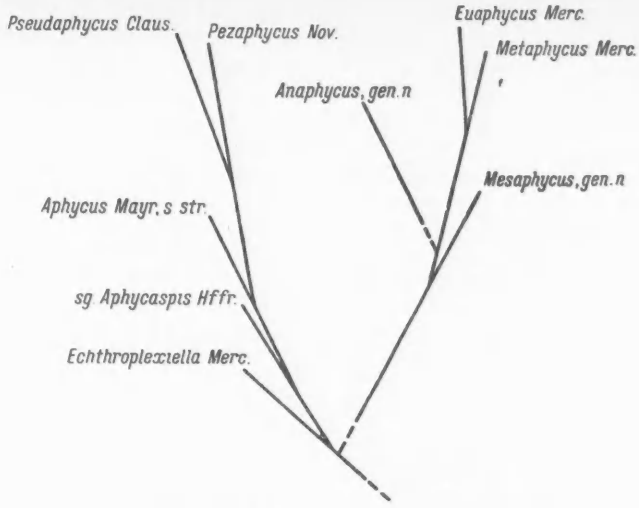



Fig. 111. Scheme of the phylogenetic relationships among the genera of the group Aphycus Mayr.

white with dark spots on the femora and tibia. Abdomen violet colored, blue-green at the base. Side and under parts of thorax and abdomen reddish. Length 1.0-1.94 mm.

The male is not known in USSR. According to Mercet (1921), the antennae have whorls of long hairs, scape of antenna slightly dilated in the middle, shorter than the first two joints of the funicle, taken together, pedicel as long as broad, shorter than the succeeding joint; club unsegmented. Antennae whitish with dark spots on the upper side of the scape and pedicel. Upper part of thorax greenish-or bluish-black. Legs whitish. Abdomen blue-black. Length 1.47 mm.

Ukraine: Kiev, from Kermococcus roboris Fourc., July 18, 1912, 13 females (Rodzyahko); Kiev, from Kermococcus sp., 1950, 2 females (H. Dyadechko).

It is mentioned in the work of Dyadechko (1954). B. clara Nik. appears to be a light-colored form of B. erythrestetha.

In conclusion we wish to put forward some miscellaneous considerations regarding the phylogenetic relationships among the genera belonging to the group Aphycus Mayr. In estimating the degree of kinship we have taken into consideration the following principal characteristics: the structure and color of the antennae, the shape of the mandible, the structure of the maxillary and labial palps, the degree of development of the parapsidial grooves, the shapes of the 9th syntergite and 7th abdominal sternite, the shape of the inner and outer valves and the sheath of the ovipositor and a few others.

We think that the most generalized forms in the Aphycus branch are the species in the genus Aphycaspis Hoffer, which, coming together with the genus Aphycus, possess a number of features relating them to the genus Mesaphycus. We consider the latter as a side branch forming the inception of the progressive genera Metaphycus, Anaphycus and others (Fig. 3).

The genus Pseudaphycus, as its morphological and biological peculiarities indicate, should be considered as one of the most specialized in the Aphycus branch.

As we had at our disposal only a minority of genera of the Aphycus group, the suggested scheme of the phylogenetic relationships among the genera of the group is only of a preliminary nature. Certain supplementary material is provided by a study of the genus Echthroplexiella Merc. which, evidently, is the most primitive in the group and which, so far, has not been recorded in the fauna of the European parts of USSR. The primitive character of this genus is shown by the metallic coloration in certain species (E. submetalica Merc. and others), the elongated marginal, radial and postmarginal veins, the presence of almost complete parapsidial grooves and the comparatively little differentiated abdomen. The wide, almost trapezoidal, 9th abdominal syntergite and the elongated and narrow parts of the ovipositor attract attention. At the same time there are innate characteristics which indicate its specialization: – a comparatively elongated body, a depressed thorax and usually rudimentary wings which are typical of parasites pursuing hosts living on plants above ground or in roots in the soil. Closely related to the genus Echthroplexiella is the genus Erythroaphycus Comp., differing, perhaps, from the first only in the greater reduction of the venation of the fore-wing (Compere, 1947). It is possible that the branches Aphycus and Mesaphycus originate from the branch of the genus Echthroplexiella (or some other genus common with their ancestors).

The genus Blastothrix Mayr represents, evidently, an early, isolated, independent branch. On the whole, our scheme differs considerably from the one devised by Hoffer (1954), who used for its construction mainly the structure of

the antennae and the shape of the mandible but made no study of the abdominal sclerites.

It is necessary to turn one's attention to a study of the specific composition of the group in the fauna of USSR. The following figures are indicative of this rather vaguely studied question: Over the huge territory comprising the European parts of USSRa total of 18 species is known, whereas in the neighboring country of Hungary about 30 are recorded (Erdös, 1957). Research on the comparative morphology of the species in the various genera of the group and the isolation of structural, evolutionally important, generic and specific characteristics are of some importance. Also a study of the biology of the species, their host–parasite relationships and the parts they play in reducing the number of harmful insects is of definite theoretical and practical interest.

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## SUMMARY

Descriptions of 18 species of the group of genera closely allied to Aphycus Mayr (fam. Encyrtidae) are given in the paper together with keys for their identification.

All of them are found in the European part of the USSR.; two new species: Metaphycus melanus, sp. n. and Blastothrix anomala, sp. n. are included.

A new genus, Mesaphycus, gen. n. is erected for Aphycus picearum Erdös, and Aphycus nitens Kurdjumov was made the type species of another new genus, Anaphycus. Short notes on the distribution and biology are given for all the species mentioned herein.

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# ASSOCIATION OF BEES WITH LEGUMINOUS PLANTS ON THE RIGHT BANK* STEPPE OF THE UKRAINE

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The association of bees with various melittophilous plants has been known for a long time, and the importance of a thorough study of this association for revealing the evolution of different groups of flowering plants and their pollinators is beyond question. In addition, a knowledge of the trophic links of bees is essential for assessing the importance of individual species as pollinators of crop plants.

In recent times, owing to the urgent problem of providing pollinators for the ever-increasing areas under perennial grasses, particularly clover, sainfoin and alfalfa, the necessity for a serious study of the relationships of bee pollinators with leguminous plants has become obvious. This has special relevance for the obtention of a high seed yield from alfalfa, the flowers of which, as we know, are hardly pollinated at all by such a "universal" pollinator as the domestic bee. It has already been discovered that the actual pollinators of alfalfa are polytrophic and oligotrophic types of solitary bees associated with leguminous plants (Popov [1956]). Of great importance in this connection is the extent to which alfalfa pollinators are attracted by other flowering plants, primarily leguminous plants, and hence a study of the bees associated with leguminous plants in various regions of alfalfa cultivation is now assuming great practical importance in addition to its theoretical interest. At present we have V. V. Popov's information on bees which pollinate and visit leguminous plants in two localities of West Kazakhstan Region. From the neighborhood of Yanvartsevo 64 species associated with leguminous plants were recorded, and of these the most numerous in this locality were the main pollinators: Andrena labialis Kby., Melitturga clavicornis Latr., Rophites 5-spinosus Spin., Melitta leporina Panz., Bombus laesus Mor., B. silvarum L., and others (Popov [1952b]). In the vicinity of Khar'kino 53 species were recorded, and there the main and most numerous species associated with leguminous plants were Anthidiellum strigatum Panz., Anthidium florentinum F., Megachile argentata F., M. dorsalis Per., Amegilla albigena Lep., and A. velocissima Fedt. (Popov [1954]). We know that in southwest Turkmenia the visitors to leguminous plants include many short-tongued forms of bees (Colletes, Hylaeus, Hyhalictus, Nomia) and several oligotrophic species (Icteranthidium, Megachile, Amegilla, Anthophora, etc), and also a few of the main alfalfa pollinators (Eucera clypeata Er., Nomia diversipes Latr., Megachile argentata F., Tetralonia tricincta Baer, etc). According to the data of K. K. Fasulati [1953], in the steppe of Askaniya-Nova 18 species of bees are associated with leguminous plants, and of these Melitturga clavicornis Latr., Melitta leporina Pz., and Andrena sericea Chr. visit the greatest range of leguminous plants. From an analysis of the information given by A. G. Lebedev [1933] it is clear that in Kievshchina the following species were recorded more often than others on leguminous plants: Andrena ovatula K., Melitta leporina Pz., Andrena albofasciata Thoms., Megachile centuncularis L., Rophites canus Eversm., Eucera longicornis L., and others. Two species of Colletes, Andrena labialis K., A. convexiuscula K., Megachile umbecilla Gerst., Halictus 4-circtus (F.), and Bombus muscorum L. were collected by Bramson [1879] on two species of leguminous plants in the vicinity of Ekaterinoslav (Dnepropetrovsk). For Western Europe information on bees associated with leguminous plants can be found in the comprehensive works of Muller [1881] and Knuth [1898]. Knuth mentions that among the visitors to leguminous plants in various localities of Western Europe the following species occurred more often than others: Megachile argentata F., Melitta leporina Pz., Rophites canus Eversm., Anthidium strigatum Latr., Eucera longicornis L., Andrena convexiuscula Kirby, Trachusa byssina Panz., and several others. Among the oligotrophic forms associated with leguminous plants in northwest Germany Alfken [1935] also names Melitta leporina Pz., Megachile argentata F., certain Eucera, Bombus, and others.

In our table we give the pollinators and visitors to leguminous plants on the area of the right bank steppe of the Ukraine. The author collected the material by the individual capture method in several localities: in May-August, 1951 in the vicinity of Kiliya, on Stepnoi Island and in the village of Novosel'skoe, Odessa Region; in July - August, 1953 in the village of Bandurovka, Kirovograd Region; in May, 1954 in the vicinity of Kherson and the village of Novaya Tyaginka, Kherson Region; in June, 1954 on the state farm "Voznesensk" and the Vosnesensk Steppe Forestry, Nikolaev Region. On 12 species of leguminous plants I collected a total of 1805 bees, belonging to 128 species (the domestic bee was not counted). The 59 species collected on alfalfa flowers included: more often

*i.e., on the right bank of the Dnieper.

than others – Andrena albofasciata Thoms., Eucera clypeata Er., Melitta leporina Pz., Halictus eurygnathus Bluthg., Melitturga clavicornis Latr.; less frequently – Andrena flavipes Pz., Megachile argentata F., Andrena labialis Kby. and A. cordialis Mor. It should be noted that all these species were very obviously attracted to certain flowering leguminous plants, and also to some labiates, which were found as weeds among the alfalfa crops in all the collecting localities.

There is already considerable information on solitary bees which pollinate alfalfa. In Precaucasia and Central Asia the most important alfalfa pollinators (total number 161 species) are Halictus eurygnathus Bluthg., H. malachurus Kby., Andrena labialis Kby., A. flavipes Pz., A. albofasciata Thoms., Nomia diversipes Latr., Melitta leporina Pz., Melitturga clavicornis Latr., Eucera clypeata Er., etc. (Popov [1951]). A. D. Kostylev and S. N. Vinogradov [1934] name Andrena albofasciata Thoms., A. labialis Kby., and Eucera clypeata Er. as alfalfa pollinators in the Northern Caucasus; the same species composition is recorded for Essentuki (Kostylev [1935]). The main alfalfa pollinators noted in Khar'kino, West Kazakhstan Region were species associated with all leguminous plants: Andrena labialis Kby., A. flavipes Pz., Nomia diversipes Latr., Melitta leporina Pz., Megachile argentata F., M. saussurei Rad., Eucera clypeata Er., and others (Popov [1954]). In Alma-Ata Region alfalfa is pollinated by Melitta leporina Pz., Andrena albofasciata Thoms., A. flavipes Pz., Megachile argentata F., Melitturga clavicornis Latr., Bombus laesus Mor., Eucera clypeata Er. (Rymashevskaya [1951, 1952a, 1952b]). M. A. Burnasheva [1954] found that in the vicinity of Tashkent the alfalfa pollinators belong to the genera Andrena and Megachile, and occasionally Bombus spp. are encountered. For Stalingrad Region D. V. Panfilov [1952, 1956] cites as the main pollinators: Eucera clypeata Er., Melitturga clavicornis Latr., Megachile argentata F., Andrena labialis Kby., and Anthidium florentinum F. In the same region N. I. Nefedov [1953] recorded on an alfalfa crop Nomada jacobea Panz., Panurgus calcaratus Scop., P. banksianus Kby., Melitturga clavicornis Latr., and Anthophora bimaculta Pz. Records for Gorki Region include the same Melitta, Melitturga, and Eucera, as well as certain species of Andrena and Megachile (Mel'nichenko [1953]), these being recorded also for Rostov Region by N. Neverova [1949]. According to A. N. Ponomarev's data [1954] the alfalfa pollinators in Chelyabinsk Region are Eucera longicornis L., Andrena chrysopyga Schck., Rophites canus Eversm., Melitta, Melitturga, the bumble-bees B. serrisquama F. Mor., B. laesus F. Mor., and B. equestris F. In Ul'yanovsk Region the main pollinators are the same Rophites, Melitta, and Melitturga (Blagoveshchenskaya [1954a, 1954b]). N. N. Konakov and Yu. N. Pisarev [1938] cite 11 species of bees pollinating alfalfa in the vicinity of Voronezh; they attribute a particularly important role to Melitturga. Among 14 species collected on alfalfa flowers, D. S. Shapiro [1940] also mentions Eucera, Melitta, and Melitturga. For Odessa Region N. S. Davydova [1948] notes, besides Melitta and Melitturga, Andrena fulvicrus Kirby, Rophites canus Eversm., Nomada jacobea Panz., Eucera hispanicus Lep., and others. It has been pointed out (Popov [1952b]) that in Yanvartsevo, West Kazakhstan Region, the pollinators of alfalfa do not differ from its pollinators in other regions of the USSR. In various localities of Western Europe 20 species of bees have been recorded on the flowers of alfalfa crops, and these include Melitta leporina Pz., Megachile argentata F., Rophites canus Eversm., species of Eucera, Bombus, and others; in England these are the bee visitors to the yellow sweet-clover. For the neighborhood of Kiev A. G. Lebedev [1933] names Colletes marginatus Sm., Halictus albipes F., H. maculatus Sm., H. lativentris Schck., H. politus Schck., H. tumulorum L., Mellita leporina Pz., and Anthidium florentium F., Colletes hylaeiformis Ev., C. marginatus L. and Megachile umbecilla Gerst. (Bramson [1879]) are recorded for the vicinity of Dnepropetrovsk. For the Askaniya-Nova steppe K. K. Fasulati [1953] cites Melitturga clavicornis Latr., three species of Andrena, Melitta laporina Pz., Colletes marginatus Sm., Megachile argentata F. and Phiarus abdominalis Ev. Records for south Germany give Halictus morio F. and H. tumulorum L. (Bachman [1912]); in Mecklenburg – Halictus rubicundus Christ., Osmia claviventris Thoms., Anthidium strigatum Latr., Andrena pilipes F. and three species of Coelioxys; in Thuringia – two species of Bombus and Ceratina cyanea K. (Knuth [1898]). Of interest are the bee visitors to flowers of the pea tree (Caragana arborescens L.) and the black locust (Robinia pseudoacacia L.), among which have been recorded both polytrophic species and species associated with leguminous plants: Andrena albofasciata Thoms., common in the region of investigation, species of the genera Eucera, Anthophora, Bombus and others. The oligotrophic species find their food on these plants before the other leguminous plants, particularly alfalfa, flower. On flowers of the pea-tree 54 species of bees have been recorded and the females occurring more often than others were Eucera caspica Mor. var. perezi Mocs., Halictus eurygnathus Bluthg., H. marginellus Schck., H. sexcinctus F., Andrena convexiuscula Kirby, A. extricate Smoth., Megachile centuncularis L. and four species of Bombus (Knuth [1898]). In N. America alfalfa is pollinated by more than 100 species of solitary bees (Bohart [1955]; Powell [1956]); moreover, Bohart [1955] recommends that Melitta from Europe and Rophites from the Caucasus should be introduced into the USA. For Canada Stephen [1955] records five species of Bombus and six species of Megachile as alfalfa pollinators. We could cite many more works, both native and foreign, dealing with the species composition of alfalfa pollinators; the most important of them have been analyzed in V. V. Popov's paper [1956].

As we can see from the information cited, the composition of the main alfalfa pollinators in the region studied is very similar to the species composition of pol-

Bee Pollinators and Visitors to Leguminous Plants on the Right Bank Steppe of the Ukraine in 1951-1954.

| No. | Species | Medicago sativa L. | Medicago falcata L. | Melilotus officinalis Desr., M. albus Desr. | Trifolium medium L., T. fragiferum L. | Lotus corniculatus L. | Caragana arborescens L. | Robinia pseudoacacia L. | Astragalus onobrychis L. | Coronilla varia L. | Vicia cracca L. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | *Colletes hylaeiformis* Eversm. | — | — | 1 ♀ | — | — | — | — | — | — | — |
| 2 | *C. fodiens* Geoffr. | — | — | 1 ♀ (p) | — | — | — | — | — | — | — |
| 3 | *C. marginatus* Sm. | 1 ♀ (p) | — | — | — | — | — | — | — | — | — |
| 4 | *C. mlokossewiczi* Rad. | — | — | 1 ♀ | — | — | — | — | — | 1 ♀ | — |
| 5 | *Hylaeus bisinuatus* Först. | — | — | 2 ♀, 1 ♂ | — | 1 ♀ | — | — | — | — | — |
| 6 | *H. variegatus* (F.) | 1 ♀ | — | — | — | — | — | — | — | — | — |
| 7 | *Andrena morio* Brullé | — | — | — | — | — | 4 ♀, 12 ♂ | 4 ♀, 21 ♂ | — | — | — |
| 8 | *A. albopunctata* Rossi | — | — | — | — | — | 1 ♂ | — | — | — | — |
| 9 | *A. carbonaria* L. | 1 ♂ | — | — | — | — | — | 1 ♀ | — | — | — |
| 10 | *A. thoracica* F. | 1 ♂ | — | 1 ♂ | — | — | — | — | — | — | — |
| 11 | *A. tibialis* K. | — | — | — | — | — | 1 ♀ | — | — | — | — |
| 12 | *A. truncatilabris* Mor. | — | — | — | — | — | — | 4 ♀, 1 ♂ | — | — | — |
| 13 | *A. figurata* Mor. | — | — | — | — | — | 1 ♂ | 1 ♀, 1 ♂ | — | — | — |
| 14 | *A. viridescens* Viereck. | — | 1 ♀ | — | — | — | — | — | — | — | — |
| 15 | *A. scita* Ev. | — | — | — | — | — | — | 4 ♂ | — | — | — |
| 16 | *A. labialis* Kby. | 8 ♀ (5p) | — | — | — | — | — | 2 ♂ | — | — | — |
| 17 | *A. fimbriata* Br. | — | — | — | — | — | — | 1 ♀ | — | — | — |
| 18 | *A. transitoria* Mor. | 1 ♂ | — | — | — | — | — | 1 ♀ | — | — | — |
| 19 | *A. flavipes* Pz. и var. *cinerascens* Ev. | 15 ♀ (2p), 21 ♂ 5 ♀ (4p), 6 ♂ | — | 5 ♀ (4p), 1 ♂ 11 ♀ (7p), 8 ♂ | — | — | 14 ♀, 16 ♂ 1 ♀, 1 ♂ | 8 ♀, 17 ♂ 2 ♀, 1 ♂ | — 19 ♀ (7 p), 1 ♂ | — 6 ♀ | — — |
| 20 | *A. chrysopyga* Schck. | 1 ♀ (p) | — | — | — | — | — | 1 ♂ | — | — | — |
| 21 | *A. nobilis* Mor. | 1 ♀ | — | — | — | — | — | 2 ♀, 7 ♂ | — | — | — |
| 22 | *A. cordialis* Mor. | 10 ♀ (2p) | — | — | — | — | — | — | — | — | — |
| 23 | *A. propinqua* Schck. | — | — | 1 ♀ | — | — | — | 1 ♀ | — | — | — |

Bee Pollinators and Visitors to Leguminous Plants on the Right Bank Steppe of the Ukraine in 1951-1954. continued

| No. | Species | Medicago sativa L. | Medicago falcata L. | Melilotus officinalis Desr., M. albus Desr. | Trifolium medium L., T. fragiferum L. | Lotus corniculatus L. | Caragana arborescens L. | Robinia pseudoacacia L. | Astragalus onobrychis L. | Coronilla varia L. | Vicia cracca L. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 24 | *A. sahlbergi* Mor. . . . | — | — | 1 ♀ (p) | — | — | — | — | — | — | — |
| 25 | *A. combinata* Christ. . | 4♂ | — | — | — | — | 1 ♂ | 3♂ | — | — | — |
| 26 | *A. albofasciata* Thoms. | 72 ♀ (42 p), 10 ♂ | — | 6 ♀ (3p) | 1 ♀ | — | 9 ♀, 13 ♂ | 42 ♀, 34 ♂ | 6 ♀ (3p), 1 ♂ | — | — |
| 27 | *A. wilkella* K. . . . . | 1 ♀ (p) | — | 1 ♀ | 1 ♀ (p) | — | — | — | — | — | — |
| 28 | *Melitturga clavicornis* Latr. . . . . | 16♀ (9p), 36♂ | — | 17♀ (16p), 1♂ | — | — | — | — | — | — | — |
| 29 | *Halictus quadricinctus* (F.) . . . . . | 3 ♀ (2p) | — | 5 ♀ (4 p) | — | — | 2 ♀ | 29 ♀ | — | — | — |
| 30 | *H. sexcinctus* (F.) . . | 1 ♀ (1p) | — | — | — | — | 15 ♀ | 3 ♀ | — | — | — |
| 31 | *H. eurygnathus* Blüthg. | 22 ♀ (9 p) | — | 3 ♀ (2 p) | — | — | 21 ♀ | 62 ♀ | — | — | — |
| 32 | *H. maculatus* Sm. . . | — | — | 3 ♀ (2p) | — | — | 6 ♀ | 15 ♀ | — | — | — |
| 33 | *H. elegans* Lep. . . . | — | — | — | — | — | 1 ♀ | — | — | — | — |
| 34 | *H. vestitus* Lep. . . . | 6 ♀ (2) | — | — | — | — | 6 ♀ | 12 ♀ | — | 1 ♀ | — |
| 35 | *H. subauratus* Rossi . | — | — | — | — | — | 1 ♀ | — | — | — | — |
| 36 | *H. semitectus* Mor. . . | — | — | — | — | — | 1 ♀ | — | — | — | — |
| 37 | *H. smaragdulus* Vach. | — | — | — | — | — | — | 2 ♀ | — | — | — |
| 38 | *H. kessleri* Brams. . . | 1 ♀ | — | — | — | — | 1 ♀ | 10 ♀ | — | — | — |
| 39 | *H. xanthopus* (K.) . . | 2 ♀ | — | — | — | — | 5 ♀ | 6 ♀ | — | — | — |
| 40 | *H. zonulus* Sm. . . . . | — | — | — | — | — | 1 ♀ | 2 ♀ | — | — | — |
| 41 | *H. albomaculatus* Luc. | 1 ♀ | — | — | — | — | — | — | 1 ♀ | — | — |
| 42 | *H. morbillosus* Kriechb. . . . . | 6 ♀ (3p) | — | 14 ♀ (2p) | — | — | 4 ♀ | 22 ♀ | — | — | — |
| 43 | *H. leucozonius* Schrk. | 1 ♀ | — | — | — | — | — | 2 ♀ | — | — | — |
| 44 | *H. interruptus* Panz. . | — | — | — | — | — | 2 ♀ | 5 ♀ | — | — | — |
| 45 | *H. marginellus* Schrk. | — | — | — | — | — | 25 ♀ | 6 ♀ | — | — | — |

Bee Pollinators and Visitors to Leguminous Plants on the Right Bank Steppe of the Ukraine in 1951-1954.

continued

| No. | Species | Medicago sativa L. | Medicago falcata L. | Melilotus officinalis Desr., M. albus Desr. | Trifolium medium L., T. fragiferum L. | Lotus corniculatus L. | Caragana arborescens L. | Robinia pseudoacacia L. | Astragalus onobrychis L. | Coronilla varia L. | Vicia cracca L. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 46 | *Halictus politus* Schck. | — | — | 1 ♀ (P) | — | — | — | 12 ♀ | — | — | — |
| 47 | *H. griseolus* Mor. . . . | 1 ♀ | — | — | — | — | 1 ♀ | 3 ♀ | — | — | — |
| 48 | *H. lucidulus* Schck. . | — | — | — | — | — | 5 ♀ | 2 ♀ | 2 ♀ | — | — |
| 49 | *H. villosulus* K. . . . | 1 ♀ | — | — | — | — | 1 ♀ | — | — | — | — |
| 50 | *H. puncticollis* Mor. . | — | — | — | — | — | 1 ♀ | 4 ♀ | — | — | — |
| 51 | *H. buccalis* Per. . . . | — | — | — | — | — | 4 ♀ | — | — | — | — |
| 52 | *H.* aff. *laevis* (K.) . . | 1 ♀ | — | — | — | — | 2 ♀ | 5 ♀ | — | — | — |
| 53 | *H. pauxillus* Schck. . | — | — | — | — | — | — | 1 ♀ | — | — | — |
| 54 | *H. albipes* F. . . . . | 1 ♀, 1 ♂ | — | — | — | — | — | 1 ♀ | — | — | — |
| 55 | *H. calceatus* Scop. n var. *rubens* Sm. . . | — | — | — | — | — | 2 ♀ | 1 ♀ | — | — | — |
| | | — | — | — | — | — | 2 ♀ | 2 ♀ | — | — | — |
| 56 | *H. morio* F. . . . . | — | — | — | — | — | 1 ♀ | — | — | — | — |
| 57 | *H. leucopus* K. . . . . | — | — | — | — | — | 5 ♀ | — | — | — | — |
| 58 | *H. viridiaeneus* Blüthg. | 1 ♀ | — | — | — | — | — | — | — | — | — |
| 59 | *Sphecodes fuscipennis* Germ. . . . . | 1 ♀ | — | — | — | — | 2 ♀ | — | — | — | — |
| 60 | *Sph. gibbus* L. . . . . | 1 ♀ | — | — | — | — | 1 ♀ | — | 1 ♀ | — | — |
| 61 | *Sph. divisus* K. . . . | — | — | — | — | — | 3 ♀ | — | — | — | — |
| 62 | *Nomia diversipes* Latr. | 4 ♀ (1p) | — | 1 ♀ | — | 1 ♀ | — | — | — | — | — |
| 63 | *N. ruficornis* Spin. . . | — | — | — | — | 1 ♂ | — | — | — | — | — |
| 64 | *Rophites quinquespinosus* Spin. . . . . | — | — | 2 ♂ | — | — | — | — | — | — | — |
| 65 | *R. canus* Eversm. . . | 1 ♂ | — | — | — | — | — | — | — | — | — |
| 66 | *Systropha curvicornis* Scop. . . . . | — | — | — | — | — | — | — | 3 ♂ | — | — |
| 67 | *Melitta leporina* Pz. . | 19 ♀ (10p), 10 ♂ | — | 4 ♀ (2p) | — | — | — | — | — | — | — |

Bee Pollinators and Visitors to Leguminous Plants on the Right Bank Steppe of the Ukraine in 1951-1954. continued

| No. | Species | Medicago sativa L. | Medicago falcata L. | Melilotus officinalis Desr., M. albus Desr. | Trifolium medium L., T. fragiferum L. | Lotus corniculatus L. | Caragana arborescens L. | Robinia pseudoacacia L. | Astragalus onobrychis L. | Coronilla varia L. | Vicia cracca L. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 68 | *M. nigricans* Alfken | — | — | 1 ♂ | — | — | — | — | — | — | — |
| 69 | *Dasypoda plumipes* Pz. | 1 ♂ | — | — | — | — | — | — | — | — | — |
| 70 | *Paranthidiellum lituratum* Pz. | — | — | 1 ♂ | — | — | — | — | 1 ♂ | — | — |
| 71 | *Anthidium florentinum* F. | — | — | — | — | — | — | — | 2 ♂ | — | — |
| 72 | *Hoplitis parvula* Duf. et Pér. | — | — | 2 ♀ (2p) | — | — | — | — | — | — | — |
| 73 | *Osmia aenea* L. | 1 ♀ (p) | — | — | — | — | 1 ♀ | — | — | — | — |
| 74 | *O. fulviventris* Panz. | 1 ♀ | — | — | — | — | — | — | 1 ♀ | — | — |
| 75 | *O. aurulenta* Panz. | 1 ♀ | — | 1 ♀ (p) | — | — | — | 3 ♀ | — | — | — |
| 76 | *O. rufa* L. | — | — | — | — | — | 11 ♀ | — | — | — | — |
| 77 | *O. cornuta* Latr. | — | — | — | — | — | 1 ♀ | 1 ♀ | — | — | — |
| 78 | *Megachile argentata* F. | 9 ♀ (7p) | 9 ♀ (8p) | 1 ♀ (p) | — | 11 ♀ (11p) | — | — | 1 ♀ | 4 ♀ (3p), 1 ♂ | — |
| 79 | *M. pilidens* Alfk. | — | 3 ♂ | — | — | — | — | — | — | 1 ♀ (p) | — |
| 80 | *M. rotundata* (F.) | 1 ♂ | — | — | — | — | — | — | 1 ♀ | — | — |
| 81 | *M. apicalis* Spin. | — | — | 1 ♂ | — | — | — | — | — | — | — |
| 82 | *M. leucomalla* Gerst. | — | — | — | — | — | — | — | 5 ♀ | — | — |
| 83 | *M. centuncularis* L. | 1 ♀ | — | — | — | — | — | — | 1 ♀ (p) | — | — |
| 84 | *M. octosignata* Nyl. | 1 ♂ | — | — | — | — | — | — | — | — | — |
| 85 | *M. circumcincta* K. | — | — | — | — | — | 1 ♀ | — | — | — | — |
| 86 | *M. maritima* K. | 2 ♀ | — | — | — | — | — | — | 2 ♀ | — | — |
| 87 | *M. ericetorum* Lep. | — | — | — | — | — | — | — | 8 ♀ (6p) | — | — |
| 88 | *Coelioxys afra* Lep. | 1 ♂ | — | — | — | 1 ♀ 1 ♂ | — | — | — | — | — |
| 89 | *C. laticauda* Mor. | — | — | — | — | — | — | — | 1 ♀ | — | — |
| 90 | *Nomada fucata* Pz. | 2 ♀, (1 ♂ | — | — | — | — | 1 ♀ | 9 ♂ | 1 ♀, 1 ♂ | — | — |

Bee Pollinators and Visitors to Leguminous Plants on the Right Bank Steppe of the Ukraine in 1951-1954. continued

| No. | Species | Medicago sativa L. | Medicago falcata L. | Melilotu officinalis Desr., M. albus Desr. | Trifolium medium L., T. fragiferum L. | Lotus corniculatus L. | Caragana arborescens L. | Robinia pseudoacacia L. | Astragalus onobrychis L. | Coronilla varia L. | Vicia cracca L. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 91 | *Nomada mauritannica* Lep. var. *manni* Mor. | — | — | — | — | — | 3♀, 9♂ | 5♀, 7♂ | — | — | — |
| 92 | *N. basalis* H. Sch. . . | 1♂ | — | — | — | — | — | 1♂ | — | — | — |
| 93 | *N. flavopicta* K. . . . | 1♂ | — | — | — | — | — | — | — | — | — |
| 94 | *N. zonata* Pz. . . . . | — | — | — | — | — | — | 1♂ | — | — | — |
| 95 | *N. flavoguttata* K. . . | — | — | — | — | — | — | 1♀ | — | — | — |
| 96 | *N. furva* Pz. . . . . | — | — | — | — | — | 1♂ | — | — | — | — |
| 97 | *N. erythrocephala* Mor. var. *helvetica* Schmied . . . . . | — | — | — | — | — | — | — | 1♀ | — | — |
| 98 | *N. mutabilis* Mor. . . | — | — | — | — | — | — | 1♀ | — | — | — |
| 99 | *Pasites maculatus* Jur. | — | — | — | — | — | — | — | 3♀ | — | — |
| 100 | *Eucera nitidiventris* Mocs. | — | — | — | — | — | 135♂ | 17♀, 33♂ | — | — | — |
| 101 | *E. parvicornis* Mocs. . | 1♂ | — | — | — | — | 1♂ | — | — | — | — |
| 102 | *E. clypeata* Er. . . . . | 56♀ (48p), 6♂ | — | — | — | — | 14♂ | 112♂ | — | — | 1♂ |
| 103 | *E. similis* Lep. . . . . | 1♂ | — | — | — | — | — | — | — | — | — |
| 104 | *E. caspica* Mor. var. *perezi* Mocs. . . . . | — | — | — | — | — | 28♀ | — | — | — | — |
| 105 | *E. seminuda* Brullé . . | 5♀ (2p) | — | — | — | — | 1♂ | 13♀ | — | — | — |
| 106 | *E. nigrilabris* Lep. . . | 1♀ | — | — | — | — | — | — | — | — | — |
| 107 | *E. cinerea* Lep. . . . . | — | — | — | — | — | — | 7♂ | — | — | — |
| 108 | *E. chrysopyga* Perez. . | 1♀ | — | — | — | — | — | 2♂ | — | — | — |
| 109 | *E. hispana* Lep. . . . | 1♀ | — | — | — | — | — | — | — | — | — |
| 110 | *Tetralonia ruficollus* Brulle . . . . . | 1♀ | — | — | — | — | 3♂ | 7♂ | — | — | 1♂ |
| 111 | *T. hungarica* Friese . . | — | — | — | — | — | — | 3♂ | — | — | — |
| 112 | *T. ruficornis* F. . . . | — | — | — | 1♂ | — | — | — | — | — | — |

Bee Pollinators and Visitors to Leguminous Plants on the Right Bank Steppe of the Ukraine in 1951–1954. continued

| No. | Species | Medicago sativa L. | Medicago falcata L. | Melilotus officinalis Desr., M. albus Desr. | Trifolium medium L., T. tragiferum L. | Lotus corniculatus L. | Caragana arborescens L. | Robinia pseudoacacia L. | Astragalus onobrychis L. | Coronilla varia L. | Vicia cracca L. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 113 | *Tetralonia salicariae* Lep. | — | — | — | — | — | — | — | 2 ♀ 1 ♂ | — | — |
| 114 | *T. nana* Mor. | — | — | 1 ♀ | — | — | — | — | — | — | — |
| 115 | *T. scabiosae* Mocs. | — | — | 1 ♀ | — | — | — | — | — | — | — |
| 116 | *T. malvae* Rossi | — | — | 1 ♀ | 1 ♀ (p) | — | — | — | — | — | — |
| 117 | *Anthophora retusa* L. and var. *meridionalis* Pér. | — 2 ♂ | — | — | — | — | 5 ♀, 80 ♂ | 7 ♀, 15 ♂ 4 ♂ | — | — | — |
| 118 | *Melecta luctuosa* Scop. | — | — | — | — | — | 2 ♀, 6 ♂ 9 ♀, 13 ♂ | 3 ♂ | — | — | — |
| 119 | *Ceratina nigrolabiata* Fr. | — | — | — | — | — | — | — | 1 ♀ | — | — |
| 120 | *C. acuta* Friese | — | — | — | — | — | — | 1 ♀ | — | — | — |
| 121 | *Bombus helferanus tristis* Seidl. | — | — | — | — | — | — | 2 ♀ | — | — | — |
| 122 | *B. muscorum* L. | 1 ♀ (p) | — | — | — | — | 7 ♀ | 2 ♀ | 1 ♀ (p) | — | 1 ♀ |
| 123 | *B. zonatus* (Sm.) ssp. *apicalis* F. Mor. | 4 ♀ | — | — | — | — | 5 ♀ | 2 ♀ | — | — | — |
| 124 | *B. serrisquama* Mor. | — | — | — | — | — | — | — | — | 1 ♀ (p) | — |
| 125 | *B. lapidarius* L. | — | — | 1 ♀ | — | — | — | 2 ♀ | — | — | — |
| 126 | *B. fragrans* Pall. | — | — | — | — | — | — | 2 ♀ | — | — | — |
| 127 | *B. terrestris* L. | 1 ♀ (p) | — | — | — | — | — | 1 ♀ | — | — | — |
| 128 | *B. hortorum* L. | 1 ♀ | — | — | 3 ♀ | 1 ♀ | — | — | — | 11 ♀ (8 p) | — |
| 129 | *B. argillaceus* Scop. | 2 ♀ | — | — | — | — | 1 ♀ | 2 ♀ | — | — | — |
| | | 288 ♀ (153 p), 8 ♀ (2 p), 108 ♂ | 10 ♀ (8 p), 3 ♂ | 84 ♀ (49 p), 1 ♀, 18 ♂ | 3 ♀ (2 p), 3 ♀, 1 ♂ | 14 ♀ (11 p), 1 ♀, 2 ♂ | 225 ♀, 307 ♂ | 336 ♀, 296 ♂ | 57 ♀ (17 p), 1 ♀ (p), 10 ♂ | 14 ♀ (5 p), 11 ♀ (3 p), 1 ♂ | 1 ♀, 2 ♂ |

**Total:** ♀ 1032 (245 p), ♀ 25 (11 p), ♂ 748 = 1805

linators of this crop in almost all the regions of its cultivation on the territory of the USSR, and such species as Melitta leporina Pz., and Megachile argentata F. are common also to Western Europe.

On flowers of the yellow (Melilotus officinalis Desr.) and white sweetclover (M. albus Desr.) 30 species of bees were collected, six of these species on the white sweetclover (Andrena flavipes Pz. var. cinerascens Ev., Rophites 5-spinosus Spin., Melitta leporina Pz., Hoplitis parvula Duf. et Per., Osmia aurulenta Panz. and Megachile apicalis Spin.) and 26 species on flowers of the yellow sweetclover, the predominant ones among the visitors to the latter being Melitturga clavicornis Latr., Halictus morbillosus Kriechb. and Andrena flavipes Pz. var. cinerascens Ev. A small number are known from the literature. Of the 63 species collected on flowers of the black locust the most numerous, apart from Halictus females, were Andrena albofasciata Thoms., and Eucera nitidiventris Mocs. The published information on bee pollinators and visitors to flowers of the pea tree and black locust is rather limited. For Yanvartsevo records of visitors to the pea tree include one species of Colletes, Andrena haemorrhoa F., A. thoracica F., Halictus sp., Xylocopa valga Gerst., Eucera sp., Anthophora pedata Eversm., A. monacha Erichs., A. ershowi Fedt., Bombus scythes Skor., Melecta sp., and Sphecodes sp. (Popov [1952b]). For Western Europe Knuth [1898] names only Bombus lapidarius L. The only visitors to the black locust are, apart from the domestic bee, Andrena ovatula K. and Anthophora acervorum L. for Kievshchina (Lebedev [1933]) and Bombus agrorum F. for Western Europe (Knuth [1898]).

The number of species of bees collected on the flowers of the other leguminous plants mentioned in the table is very small, since these plants were encountered relatively rarely in the region studied. Among the visitors to them were noted those associated with leguminous plants: Andrena albofasciata Thoms., Megachile argentata F., as well as M. ericetorum Lep., M. leucomalla Gerst., and certain other representatives of Megachile.

It is clear from the material examined that the main visitors and pollinators of leguminous plants on the right bank steppe of the Ukraine are Andrena albofasciata Thoms., A. flavipes Pz. and its var. cinerascens Ev., Eucera clypeata Ev., Halictus eurygnathus Bluthg., H. morbillosus Kriechb., H. quadricinctus F., Melitturga clavicornis Latr., Megachile argentata F., and Melitta leporina Pz. This species composition is reminiscent of the composition of the pollinators of leguminous plants in Yanvartsevo, situated east of the steppe zone (Popov [1952b]), and differs from that in Khar'kino, which is characterized by a desert relief, in the presence of several southern species, mainly of the genera Megachile and Amegilla, and the absence of Melitturga clavicornis Latr. (Popov [1954]). Melitturga, and also Eucera clypeata Ev. are absent among the visitors to leguminous plants in the neighborhood of Kiev, in the north of the forest-steppe zone (Lebedev [1933]). In Western Europe the bee fauna associated with leguminous plants also bears a geographical and zonal stamp.

## SUMMARY

The fauna of solitary bee polinators and visitors to leguminous plants was studied during 1951-1954 in different localities of the right bank steppe of the Ukraine.

On the flowers of 12 species of leguminous plants there were collected 1805 specimens of bees belonging to 129 species (domestic bees were not counted). The main ones were Andrena albofasciata Thoms., Andrena flavipes Pz. and its var. cinerascens Ev., Eucera clypeata Er., Halictus eurygnatus Bluthg., H. morbillosus Kriechl., H. quadricinctus F., Melitturga clavicornis Latr., Megachile argentata F. and Melitta leporina Pz. Nearly all of them are pollinators of alfalfa in the region investigated.

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# PHENOLOGY OF THE FLIGHT OF DRAGON-FLIES (ODONATA) IN THE ALTAI STEPPES AND SOME OF THE REGULARITIES OF THIS PHENOMENON

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Studies of the seasonal cycles in the development of dragon-flies, that is to say, of the appearance and disappearance of species, replacements of some species by others, variations in these intervals, and so forth, are subject to several major difficulties, as Bartenev (1930) has already pointed out.

Aside from the factors listed by Bartenev (1930), we might mention the annual periodicity in the development of some species, which determines the frequency of the species and, consequently, the ease with which it may be observed; for instance, during massive increase a species easily lends itself to phenological observations, whereas during periods of low increase it easily escapes notice and is observed only some time after its actual appearance. This factor makes it essential that conclusions be based on data obtained over many years. These multiannual observations also eliminate deviations due to meteorological factors affecting the advent of spring and summer conditions in individual years, these factors being very important and delaying faunal development over many days (Kolosov, 1915). Then it must be remembered that the condition and nature of the body of water may also be noticeably influential on the times of development of dragon-flies, as we observed in the lakes near Biisk; when the lake is small and well heated emergence occurs earlier than in a deep lake with colder water.

Consequently, if we wish to obtain a picture of the flight times of dragon-flies in some locality, we must study emergence under different conditions and in different bodies of water.

Studies on the flight of dragon-flies in Siberia have barely begun, although Bartenev (1930) presented a table of times of emergence and disappearance for 26 species. However, it is apparent that it is impossible to construct such a table to summarize the data from Western Siberia (principally Tomsk), Minusinsk, Yakutsk, Dahuria, and the Ussuriiskii Territory. Bartenev (1930) himself mentioned the considerable nonconcordance of emergence even in a single locality (near Minusinsk), but under different conditions emergence occurred earlier in the steppe sections than in the taiga.

In contrast to Bartenev (1930), I have taken the territory of the Altai steppes, which is extensive but more or less uniform in condition, the observations being carried out four years in succession and at greatly differing stations.

In arranging the data on dragon-fly flights from Tomsk, Narym, the northern part of the Barabinskaya steppe, and so forth, I have not considered it possible to bring them together since, for one thing, these data are more fragmentary, referring to only one year, and for another, the emergence times are clearly more stretched out, since the period of plant activity in each area is not the same: spring in the Altai steppe begins two weeks earlier in comparison with Tomsk and this difference is even greater in comparison with Narym.

As for the groups established by Bartenev (1930), uniting different species by flight times, these are puzzling, since species which appear and disappear simultaneously are placed in different groups, as may be seen in all the tables he gives (Siberia, Smolensk, Germany, Rostov-on-Don, etc.).

It is clear that this is an artificial arrangement where the flight of species is made to conform to some group which is formed according to the ideas of the author of that work, not so much on the basis of flight characteristics as on his views on the origins of species, biological characteristics, and so forth.

In this study of the flight of dragon-flies in the Altai steppes we have avoided such artificial arrangements and strictly subordinated the classification to the flight characteristics of the dragon-flies.

The present work is not only of theoretical interest, as an elaboration of one of the essential problems in dragon-fly ecology, but is of practical importance in defining the times of greatest danger of infection of water birds with prosthogonimosis and plagiorchosis; this should be considered by veterinary workers when organizing prophylactic measures in the focal areas of these diseases.

## Flight Period of Dragon-Flies

In the Altai steppes spring begins early, then a cold spell sets in, and then summer follows. Thus, spring is interrupted by a cold period which is observed soon after the appearance of the first species of dragon-flies. Weather conditions during the initial period of development of the dragon-fly fauna are comparatively constant, therefore. True, in other instances the cold period not only suspends breeding activity, but also destroys all imaginal dragon-flies, such that development begins anew and many species

are distinguished by particularly rapid and simultaneous emergence.

The flight period of dragon-flies in the Altai steppes begins about May 20 ( ± 2-3 days), not counting the appearance of the overwintering adults of Sympycna braueri Bianchi, and ends about October 15, when a few species are still flying. Solitary individuals of the latter may be flying even later (up to October 20) during a delayed autumn. Thus, the entire period of aerial activity of dragon-flies in the Altai steppes is five months.

In the Moscow and Smolensk regions this period is different: Here the first appearance of dragon-flies (Bartenev, 1930) is on May 10 and final disappearance is on September 20, that is, they appear and die out earlier than in the Altai steppes and the duration of the entire flight period is four months and ten days; this, obviously, does not correspond to reality, since one would expect the reverse situation, that is, a lengthening of the flight period in the warmer climate of the central belt of the European part of the USSR, where spring begins earlier and winter later.

In Germany, where climatic conditions are even milder, the duration of the flight period of dragon-flies is from April 20 to November 1, that is, of six months' and ten days' duration, considerably exceeding the duration of the flight period of dragon-flies in the Altai steppes, which is understandable.

Thus, it is clear that the Moscow data are incomplete and cannot be considered. The position of Moscow and Smolensk should be intermediate between Western Siberia and Germany. Actually, if we use the data of Kolosov (1925) for the Yaroslav region and D'yakonov (1922) for the Olonets region, it appears that in the north of the European part of the USSR flight begins on May 15 and terminates at the beginning of October. If we bear in mind that autumn flight strongly depends on weather conditions, we may justifiably extend it in this region by 10 days, or to October 20.

Thus, for these areas the extent of the flight period of dragon-flies may be stated to be five months and five days – very similar to ours, but by no means shorter. Of course, more detailed investigations in these areas would establish earlier appearance dates and later dates of last flight.

Since terminal flight is usually overlooked and temporary disappearances are mistaken for terminal ones, in the table below we have included only data on the initiation of flight in areas lying in different climatic zones; this enables us to resolve the question of the general duration of dragon-fly flight during the year according to the climatic characteristics of the localities:

| | |
|---|---|
| 1) Altai steppes | May 20 |
| 2) Central belt of the European USSR | May 10 |
| 3) Germany | April 20 |
| 4) Northern belt of the European USSR | May 15 |
| 5) Southern belt of the European USSR | May 5 |
| 6) Kuban' district | May 1 |
| 7) Environs of Tiflis | April 25 |

Thus, the regions concerned may be arranged in the following manner on the basis of the time of the beginning of dragon-fly flight: Germany – Tiflis – Kuban' – southern European USSR – central belt of the European USSR – northern belt of the European USSR – steppes of Western Siberia. Each of these regions differs from the next by ± 5 days. This unequivocally points to the close relationship between climatic characteristics of an area and the beginning of flight be dragon-flies, that is to say, this relationship in the dragon-flies is subject to the same regularities governing the majority of other organisms.

## Duration of Flight of Different Species of Dragon-Flies

The duration of flight of different species of dragon-flies is different and varies between 50 and 105 days, that is, some species fly more than twice as long as others. We will not examine the durations of flight of each species separately here, but will become acquainted with its variation within a genus and also with its duration in separate genera comprising different numbers of species.

The duration of flight of different species of the genus Leucorrhinia is as follows:

| | |
|---|---|
| 1) L. albifrons Burm. | 65 days |
| 2) L. dubia Lind. | 75 days |
| 3) L. rubicunda L. | 60 days |
| 4) L. pectoralis Charp. | 50 days |
| 5) L. caudalis Charp. | 70 days |

Consequently, the duration of flight of species of Leucorrhinia varies within the limits of 60 - 75 days. It may be seen from these data that there is no regularity whatever in flight duration – it is impossible to correlate our figures either with geographical origin, that is, to relate longer or shorter intervals with species of more southern or more northern origin, or with any other factors.

If it were not for the length of flight of L. dubia Lind. it would be possible to consider that the species with a southern biological preference are characterized by a longer flight period than the northern ones.

Let us compare the data for species of Sympetrum:

| | |
|---|---|
| 1) S. pedemontanum All. | 80 days |
| 2) S. sanguineum Müll. | 105 days |
| 3) S. scoticum Don | 105 days |
| 4) S. flaveolum L. | 105 days |
| 5) S. vulgatum L. | 90 days |

It is clear that this group differs strongly from the preceding but here also there are no particular regularities or these may be considered contrary to those which may be noted for the genus Leucorrhina.

For Aeschna flight duration is thus:

| | |
|---|---|
| 1) Ae. serrata Hag. | 85 days |
| 2) Ae. crenata Hag. | 95 days |
| 3) Ae. juncea L. | 75 days |
| 4) Ae. coluberculus Harr. | 75 days |

5) Ae. grandis L. . . . . 100 days
6) Ae. affinis Lind. . . . . 85 days
7) Ae. viridis Evers. . . . . 90 days

The picture is analogous in this case also.

Now let us look at the flight duration of species of two genera (Lestea and Agrion) of the suborder Zygoptera.

For the genus Lestes it is thus:

1) L. dryas Kirby . . . . . 80 days
2) L. sponsa Hans . . . . . 80 days
3) L. barbata Fabr. . . . . 90 days
4) L. virens Charp. . . . . 70 days

Here also there is no regularity: Two obviously southern species, L. barbata Fabr. and L. virens Charp., have both the longest and the shortest flight times.

For the species of Agrion we have the following flight times:

1) A. concinnum Joh. . . . . 80 days
2) A. armatum Charp. . . . . 50 days
3) A. hastulatum Charp. . . . . 80 days
4) A. vernale Hag. . . . . 55 days
5) A. puella L. . . . . 80 days
6) A. pulchellum Lind . . . . . 60 days
7) A. ecornutum Selys . . . . . 50 days

The picture is fully analogous with the preceding cases.

The flight intervals, so different in different species, compel us to seek the explanation of this phenomenon in the biological characteristics of the species and the characteristics of their conditions of existence in different climatic regions. This question is of fundamental interest because, if climatic features determine the duration of the flight period of dragon-flies as a whole, those species which develop entirely during the summer and are not dependent on either spring or autumn weather would be in a different position. This problem might be studied by contrasting the data for the Altai steppes with those for an area with a different climate.

Since the data for the central belt of the European part of the USSR (Moscow, Smolensk) are incomplete, we will compare our data with those for Germany, where the dragon-fly fauna has been very fully studied; this enabled Bartenev (1930) to construct a table, from which we have extracted the figures for flight duration (see our Table 1).

It may be seen from this table that, in general, a given species lengthens its period of adult existence when changes in climatic conditions are toward the warm side. We will not discuss the fact that our data are subject to greater fluctuations and that the flight of Agrion hastulatum Charp. is shorter in the German environment than in ours, since this evidently results from inaccuracies in the data themselves, which are also determined by the abundance of the species. Contradictory indices are provided by Sympetrum flaveolum L. and Sympetrum scoticum Don.– species which persist with us particularly late into the fall and which disappear earlier in Germany than in the Altai steppes, also appearing earlier.

The delay in the appearance of these species cannot yet be explained, but their earlier disappearance may possibly be related to the greater rainfall in the German autumn than in ours, where the "golden autumn" often persists to the beginning of November. However, according to some authors (Schiemenz, 1953) the flight times of these species in Germany is of considerably longer duration, but

Table 1

| Species | Altai Steppes | Germany | Species | Altai Steppes | Germany |
|---|---|---|---|---|---|
| *Libellula quadrimaculata* L. | 70 | 120 | *Aeschna grandis* L. | 100 | 120 |
| *Leucorrhinia albifrons* Burm. | 65 | — | *Ophiogomphus cecilia* Four. | 70 | 80 |
| *L. dubia* Lind. | 75 | 90 | *Gomphus flavipes* Charp. | 60 | 75 |
| *L. rubicunda* L. | 60 | 97 | *Calopteryx virgo* L. | 60 | 110 |
| *L. pectoralis* Charp. | 50 | 70 | *C. splendens* Harr. | 70 | 110 |
| *L. caudalis* Charp. | 70 | — | *Lestes dryas* Kirby | 80 | 80 |
| *Sympetrum pedemontanum* All. | 80 | 90 | *L. sponsa* Hans. | 80 | 105 |
| *S. sanguineum* Müll. | 105 | 105 | *L. barbata* Fabr. | 90 | 100 |
| *S. scoticum* Don. | 105 | 90 | *L. virens* Charp. | 70 | 95 |
| *S. vulgatum* L. | 90 | 100 | *Enallagma cyathigerum* Charp. | 80 | 105 |
| *S. flaveolum* L. | 105 | 90 | *Erythromma najas* Hans. | 75 | 80 |
| *Epitheca bimaculata* Charp. | 50 | 60 | *Agrion concinnum* Joh. | 80 | — |
| *Somatochlora metallica* Lind. | 75 | 95 | *A. armatum* Charp. | 50 | 55 |
| *S. flavomaculata* Lind. | 85 | 95 | *A. hastulatum* Charp. | 80 | 45 |
| *Cordulia aenea* L. | 70 | 110 | *A. vernale* Hag. | 55 | — |
| *Aeschna crenata* Hag. | 95 | — | *A. puella* L. | 80 | 120 |
| *A. juncea* L. | 75 | 90 | *A. pulchellum* Lind. | 60 | 120 |
| *A. affinis* Lind. | 85 | ? | *Nehalennia speciosa* Charp. | 70 | 60 |
| *A. coluberculus* Harr. | 75 | 80 | *Platycnemis pennipes* Pall. | 70 | 135 |

it is not clear whether this is due to incidental encounters or is a normal phenomenon.

In any case, if the duration of the flight period of dragon-flies in Germany is greater than ours by 30 days, then fluctuations in the flight duration of individual species between 0 and 65 days on the extreme, or 30 days on the average, are a perfectly natural phenomenon.

## The Appearance and Disappearance of Species and the Principal Breaks in the Development of the Fauna

Seasonal Groups. This study of the flight times of our dragon-flies has enabled us to establish eight groups, of which six may be considered basic and two transitional.

Group I (overwintering). Only one species belongs here, overwintering in the adult instar – Sympycna braueri Bianchi.

Group II (spring). This group includes spring species which appear with us either at the beginning or middle of the last ten-day period of May and disappear in the second or third ten-day periods of July: Leucorrhinia rubicunda L., L. albifrons Burm., L. pectoralis Charp., Epitheca bimaculata Charp., Agrion armatum Charp., A. vernale Hag., A. pulchellum Lind., A. ecornumtum Selys.

Group III (spring-summer). To this group belong the species which appear simultaneously with the preceding but which fly longer, terminating their existence at the end of summer, that is, during the first ten-day period of August: Libellula quadrimaculata L., Leucorrhinia dubia Lind., L. caudalis Charp., Cordulia aenea L., Agrion hastulatum Charp., Erythromma najas Hans., Platycnemis pennipes Pall.

Group IV (summer). This group embraces a number of species which appear in the beginning of summer and persist to autumn, that is, which fly from the first ten-day period of June to the end of the second ten-day period of August and which are only rarely taken during the third ten-day period of this month: Somatochlora metallica Lind., S. flavomaculata Lind., Aeschna juncea L., Calopteryx splendens Harr., Agrion concinnum Joh., A. puella L., Enallagma cyathigerum Charp., Nehalennia speciosa Charp.

Group V (first transitional). Here are included the species which appear at the middle of summer (beginning with the first ten-day period of July, rarely earlier), but which disappear early, usually at the end of August or rarely at the very beginning of September: Somatochlora graeseri Selys., Macromia sibirica Djak., Gomphus flavipes Charp., Ophiogomphus caecilia Four., and Calopteryx virgo L. These species are principally inhabitants of running waters. It should be emphasized that this group comprises species which are rarely encountered, as a result of which the beginning and end of their flight could have been missed by the observer.

Group VI (second transitional). Very similar to the preceding, but its species fly much longer and are still common in the middle of September: Lestes dryas Kirby and L. spona Hans.

Group VII (summer-autumn). This extensive group includes species which appear in the middle of summer (usually in the first ten-day period of July or rarely in the last ten-day period of June) and fly to the first or even the second ten-day period of October: Sympetrum sanguineum Müll., S. scoticum Don., S. flaveolum L., Aeschna crenata Hag., Ae. serrata Hg., Ae. viridis Evers., Ae. affinis Lind., Ae. grandis L., Lestes barbata Fabr.

Group VIII (autumn). This is a small group the species of which appear in the middle of July and fly until the first ten-day period of October: Sympetrum pedemontanum All., S. vulgatum L., Aeschna coluberculus Harr., Lestes macrostigma Evers. (?), L. virens Charp.

The ease with which the groups may be separated from one another is seen from Table 2.

## Duration of Flight in the Different Groups

The duration of flight in the different groups is not the same. Thus, the species of group II fly for 50 to 65 days, those of group III – 70 to 80 days, those of group IV 70 to 85 days, those of group V – 60 to 70 days, those of group VII – 85 to 105 days, and those of group VIII – 70 to 90 days. The flight of the early spring forms is shorter than that of the summer and summer-autumn forms. This fact deserves attention, since the termination of flight by the early spring species is not determined by meteorological conditions, as it is for many species of the summer-autumn and autumn groups; moreover the early spring group comprises species which are predominantly of northern origin. If flight duration for individual species is analyzed, it is seen that those species which are to be considered to be of southern biological preference are the ones which fly longest; for instance, of the species of Leucorrhinia the longest flying (65 days) is L. albifrons Burm., a species which does not extend far to the north.

It should be stated, however, that the phenomenon described above is not seen in the other groups.

## Variation in Abundance of Species during the Dragon-Fly Flight Period

It is perfectly natural that the number of dragon-fly species is not the same at different flight periods, but there is also a period of maximum species abundance. The numbers of species, beginning with the second ten-day period of May, are expressed by the following series of figures: 1–16–24–24–30–42–44–39–36–29–21–17–15–13–7–3–1 (Fig. 1), with the peak in the middle of summer (more accurately, in the second half of July) and with more or less analogous ascending and descending curves. This means that the increase and decrease in the numbers of species is comparatively constant, although actually the increase in the number of species proceeds at a somewhat faster rate than the decrease.

It should be pointed out that the greatest abundance of species of dragon-flies does not fall on the middle of the

TABLE 2. Flight times of dragon-flies in the Altai steppes

| Species name | Number of ten-day periods of flight | April | | | May | | | June | | | July | | | August | | | September | | | October | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III |
| *Sympycna braueri* Bianchi | | | | | | | | | | | | | | | | | | | | | | |
| *Leucorrhinia rubicunda* L. | 6.0 | | | | | | | | | | | | | | | | | | | | | |
| *L. albifrons* Burm. | 6.5 | | | | | | | | | | | | | | | | | | | | | |
| *L. pectoralis* Charp. | 5.0 | | | | | | | | | | | | | | | | | | | | | |
| *Epitheca bimaculata* Charp. | 5.0 | | | | | | | | | | | | | | | | | | | | | |
| *Agrion armatum* Charp. | 5.0 | | | | | | | | | | | | | | | | | | | | | |
| *A. vernale* Hag. | 5.5 | | | | | | | | | | | | | | | | | | | | | |
| *A. pulchellum* Lind. | 6.0 | | | | | | | | | | | | | | | | | | | | | |
| *A. ecornutum* Selys | 5.0 | | | | | | | | | | | | | | | | | | | | | |
| *Libellula quadrimaculata* L. | 7.0 | | | | | | | | | | | | | | | | | | | | | |
| *Leucorrhinia dubia* Lind. | 7.5 | | | | | | | | | | | | | | | | | | | | | |
| *L. caudalis* Charp. | 7.0 | | | | | | | | | | | | | | | | | | | | | |
| *Cordulia aenea* L. | 7.0 | | | | | | | | | | | | | | | | | | | | | |
| *Agrion hastulatum* Charp. | 8.0 | | | | | | | | | | | | | | | | | | | | | |
| *Erythromma najas* Hans. | 7.5 | | | | | | | | | | | | | | | | | | | | | |
| *Platycnemis pennipes* Pall. | 7.0 | | | | | | | | | | | | | | | | | | | | | |
| *Somatochlora metallica* Lind. | 7.5 | | | | | | | | | | | | | | | | | | | | | |
| *S. flavomaculata* Lind. | 8.5 | | | | | | | | | | | | | | | | | | | | | |
| *Aeschna juncea* L. | 7.5 | | | | | | | | | | | | | | | | | | | | | |
| *Calopteryx splendens* Harr. | 7.0 | | | | | | | | | | | | | | | | | | | | | |
| *Agrion concinnum* Joh. | 8.0 | | | | | | | | | | | | | | | | | | | | | |
| *A. puella* L. | 8.0 | | | | | | | | | | | | | | | | | | | | | |
| *Enallagma cyathigerum* Charp. | 8.0 | | | | | | | | | | | | | | | | | | | | | |
| *Nehalennia speciosa* Charp. | 7.0 | | | | | | | | | | | | | | | | | | | | | |
| *Somatochlora graeseri* Selys | ? | | | | | | | | | | | | | | | | | | | | | |
| *Macromia sibirica* Djak. | ? | | | | | | | | | | | | | | | | | | | | | |
| *Gomphus flavipes* Charp. | 6.0 | | | | | | | | | | | | | | | | | | | | | |
| *Ophiogomphus cecilia* Four. | 7.0 | | | | | | | | | | | | | | | | | | | | | |
| *Calopteryx virgo* L. | 6.0 | | | | | | | | | | | | | | | | | | | | | |
| *Lestes dryas* Kirby. | 8.0 | | | | | | | | | | | | | | | | | | | | | |
| *L. sponsa* Hans. | 8.0 | | | | | | | | | | | | | | | | | | | | | |
| *Sympetrum sanguineum* Müll. | 10.5 | | | | | | | | | | | | | | | | | | | | | |
| *S. scoticum* Don. | 10.5 | | | | | | | | | | | | | | | | | | | | | |
| *S. flaveolum* L. | 10.5 | | | | | | | | | | | | | | | | | | | | | |
| *Aeschna crenata* Hag. | 9.5 | | | | | | | | | | | | | | | | | | | | | |
| *A. serrata* Hag. | 8.5 | | | | | | | | | | | | | | | | | | | | | |
| *A. viridis* Evers | 9.0 | | | | | | | | | | | | | | | | | | | | | |
| *A. affinis* Lind. | 8.5 | | | | | | | | | | | | | | | | | | | | | |
| *A. grandis* L. | 10.0 | | | | | | | | | | | | | | | | | | | | | |
| *Lestes barbata* Fabr. | 9.0 | | | | | | | | | | | | | | | | | | | | | |
| *Sympetrum pedemontanum* All. | 8.0 | | | | | | | | | | | | | | | | | | | | | |
| *S. vulgatum* L. | 9.0 | | | | | | | | | | | | | | | | | | | | | |
| *Aeschna coluberculus* Harr. | 7.5 | | | | | | | | | | | | | | | | | | | | | |
| *Lestes macrostigma* Evers | ? | | | | | | | | | | | | | | | | | | | | | |
| *L. virens* Charp. | 7.0 | | | | | | | | | | | | | | | | | | | | | |

Group II (spring)

Group III (spring-summer)

Group IV (summer)

Group V (first transitional)

Group VI (second transitional)

Group VII (summer-autumn)

Group VIII (autumn)

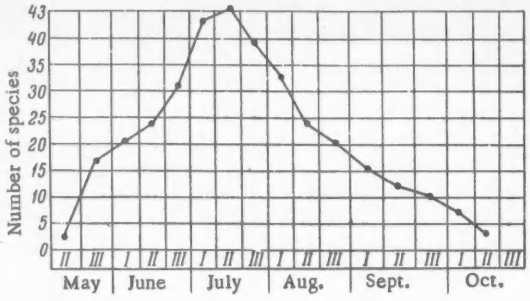


Fig. 1. Abundance of dragon-fly species in the Altai steepes during the course of the summer.

flight period but is moved back closer to the spring; in fact, if the flight period of dragon-flies extends from the third ten-day period of May to the second ten-day period of October, that is, 15 ten-day periods, then the middle of the flight period should fall at the end of the third ten-day period of July or at the beginning of the first ten-day period of August, whereas in fact we observe the greatest abundance of species in the second ten-day period of July, which is to day that a displacement of the maximum by almost 1½ ten-day periods is observed.

## Frequency of Appearance and Disappearance of Dragon-Fly Species during the Flight Period

The first appearance of dragon-flies on the third ten-day period of May and the last on the second ten-day period of July. The appearance of new species proceeds in the form of a broken line (Fig. 2) which is based on the following figures: In the second ten-day period of May

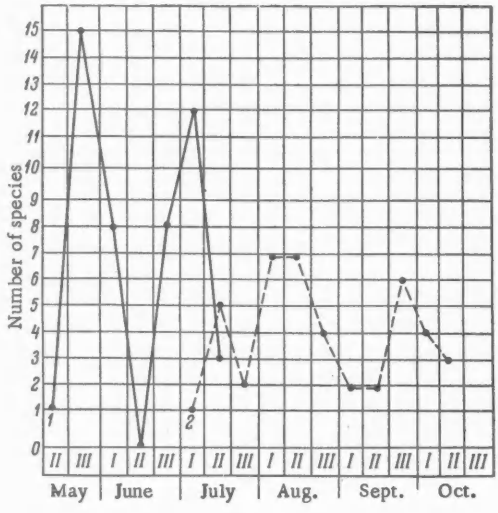


Fig. 2. Appearance (1) and disappearance (2) of dragon-fly species in the Altai steepes.

there is one species, in the third +15; in the first ten-day period of June +8, in the second +0, in the third +8; in the first ten-day period of July +12, in the second +3, and in the third ten-day period of July new species have already ceased to appear.

Thus, toward the middle of summer the development of the dragon-fly fauna ceases completely and after this breeding is carried out only by a few individuals of species encountered earlier, and the gradual disappearance of dragon-flies occurs.

The disappearance of the spring species of dragon-flies begins in the first ten-day period of July in the Altai steppes, that is, when the autumn fauna begins to develop From this time on a reduction in the number of species proceeds uninterruptedly to the second ten-day period of October, that is, to the complete disappearance of dragon-flies.

The disappearance of species proceeds in the same manner as their appearance – not gradually, but in leaps, as may be seen from the curve in Fig. 2, which has been constructed on the basis of the following figures: In the first ten-day period of July one species died out, in the second five, in the third two; in the first ten-day period of August seven, in the second seven, in the third four; in the first ten-day period of September two, in the second two, in the third six; in the first ten-day period of October four, and finally in the second ten-day period of October the last three species die out.

Thus, the appearance of new species and the disappearance of some of those previously appeared take place side by side during the first half of July; this period is therefore a breaking point in the development of the fauna, when the spring fauna begins to be replaced by the summer or even the fall one.

## On the Generic Composition of the Dragon-Fly Fauna at Various Periods of Flight

The seasonal nature of the appearance of dragon-flies of different genera is rather clearly expressed in the Altai steppes.

The earliest breeding (spring) species are those of the genera Leucorrhinia and Agrion. The first genus belongs entirely to groups II and III, while the second still occupies an important place in group IV, but is not encountered later. The Cordulidae (with one exception) belong to groups III and IV.

Aeschna, Sympetrum, and Lestes are summer-autumn genera and belong to groups VI and VIII.

Group V (the first transitional) includes several species associated with flowing waters (with one exception) and cannot be ascribed to the fauna of either the first or the second half of the summer; this group includes individual species of different genera: Somatochlora, Macromia, Gomphus, Ophiogomphus, and Calopteryx.

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# ON THE FAUNA OF BLOODSUCKING DIPTERA IN THE NENETS NATIONAL REGION AND THE NORTH OF THE KOMI ASSR

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The bloodsucking insect fauna of the north of the European part of the USSR, in particular the Nenets National Region, has been the subject of some detailed works by Breev (1948), Monchadskii (1950), and Berzina (1953). These authors carried out their observations in the lower reaches of the Pechora, in the environs of Nizhnaya Kamenka (Nenets National Region). The remaining areas of the Nenets National Region and the northern part of the Komi ASSR have so far remained very poorly studied. Moreover, the problem of bloodsucking Diptera has acquired great importance in the north, particularly considering the further agricultural assimilation of the north projected by the 20th Congress of the CPSU.

In order to further study the bloodsucking Diptera and the factors influencing their activity, we undertook an expedition to investigate a number of places in the northern part of the Komi ASSR and the Nenets National Region in the summer of 1955.

The result of this work is the material here presented, which we obtained from June 28 to August 10, 1955, by examining localities situated along the Pechora River: in the Komi ASSR (taiga) – the environs of Pechora and Ust'-Tsil'ma; in the Nenets National Region (forest-tundra)– the environs of Nar'yan-Mar and Nikitsy (20 km north of Nar'yan-Mar). The environs of Pechora and Ust'-Tsil'ma were investigated twice, at the end of June and in the first ten days of August; Nar'yan-Mar and Nikitsy were only investigated in July.

The collection and quantitative estimation of the insects was carried out by Monchadskii's (1950) method, using a Berezantsev attachment for 5 minutes. Investigations were carried out in the morning, at mid-day, and in the evening every day and, once at each locality, around the clock every two hours. The following were determined at the same time that the insects were collected: the air temperature, the relative humidity (with an Assman psychrometer), the wind velocity (with a Fuss anemometer), and the atmospheric pressure (with an anaeroid barometer).

We collected a total of 7226 specimens of Diptera belonging to five families: Culicidae, Simuliidae, Heleidae, Tabanidae, and Muscidae. The mosquitoes, black-flies, and horse-flies which were collected were determined by us in consultation with A. V. Gutsevich, the mosquito larvae were determined by A. S. Monchadskii, the muscids by A. A. Shtakel'berg, and the black-flies selectively by A. N. Berzina.

Let us consider the species making up the group of bloodsucking Diptera and the factors which influence their activity (table 1).

Mosquitoes (Culicidae). At the localities investigated in July the mosquitoes were the principal component of the bloodsucking Diptera fauna. As may be seen from Table 1, they comprised up to 91.1% of the over-all number of blood-sucking diptera attacking man. During the time of our investigation we found seven species of blood-sucking mosquitoes, belonging to three genera: Aëdes, Theobaldia, and Anopheles. Only one larva was found in the waters investigated – a Theobaldia alaskaensis Ludl. (from Ust'-Tsil'ma, at the end of July). A single mosquito (a male Anopheles maculipennis Mg.) was found in the state-room of the steamer near the city of Pechora.

The relationships between the species of mosquitoes found in the localities investigated are presented in Table 2.

It may be seen from this table that the preponderant species are A. (O) punctor, A. (O) excrucians, and A. (O) communis.

In 1955 the season of mosquito attack, according to the local inhabitants, began in the middle of June, reached its maximum in the second ten days of July, and then these became noticeably reduced in number until flight ceased in August. The intensity of mosquito attack was extremely high and, because the sun did not set, could be observed around the clock, reaching its maxima in the morning and especially in the evening and its minimum toward midnight. The absolute frequency of attack by mosquitoes on man during five minutes in July was as high as 607 specimens.

Mosquito activity was influenced by air temperature and wind. We observed mosquito attacks within temperature limits of 11 to 25°C. The range of optimal temperature, during which mosquito activity was greatest, was between 11 and 21°C.

A wind velocity of more than 1m/sec is enough to noticeably lower the frequency of mosquito attack under taiga conditions, while a wind of more than 2 m/sec strength completely stops their flight. However, individuals of the same species of mosquitoes in the forest-tundra proved to be more "wind-resistant" than the taiga ones: their attacks were still observed at wind velocities of 3-4 m/sec. This phenomenon amply confirms Monchadskii's (1950) data on the adaptations of mosquitoes to external factors.

TABLE 1. Comparative Frequencies of Attack on Man by Different Bloodsucking Diptera in the North in the Summer of 1955

| Locality investigated | Periods of the summer season | Number of counts | Relationships between families of Dipters (in %) | | | | | | | | | | | | | | | Total insects collected |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Culicidae | | | Simuliidae | | | Heleidae | | | Tabanidae | | | Muscidae | | | |
| | | | overall number | average number per count | % | overall number | average number per count | % | overall number | average number per count | % | average number | average number per count | % | average number | average number per count | % | |
| **Taiga zone** | | | | | | | | | | | | | | | | | | |
| Environs of Pechora | 2—8 VII | 27 | 246 | 10 | 80.0 | 35 | 1.3 | 10.4 | 0 | 0 | 0 | 23 | 0.9 | 7.2 | 7 | 0.3 | 2.4 | 311 |
| | 30 VII—2 VIII | 4 | 41 | 10 | 10.5 | 331 | 93 | 88.0 | 4 | 1 | 1.1 | 0 | 0 | 0 | 2 | 0.5 | 0.4 | 378 |
| Environs of Nar'yan-Mar | 11—16 VII | 12 | 117 | 10 | 86.2 | 3 | 0.2 | 1.8 | 0 | 0 | 0 | 0 | 0 | 0 | 17 | 1.4 | 12.0 | 137 |
| | 26—29 VII | 10 | 358 | 36 | 50.2 | 223 | 22 | 30.8 | 120 | 12 | 16.7 | 6 | 0.6 | 0.8 | 11 | 1.1 | 1.5 | 718 |
| **Forest-tundra zone** | | | | | | | | | | | | | | | | | | |
| Environs of Nar'yan-Mar . . . . . | 17—18 VII | 10 | 291 | 29 | 91.1 | 8 | 0.8 | 2.5 | 0 | 0 | 0 | 4 | 0.4 | 1.2 | 16 | 1.6 | 5.2 | 319 |
| Environs of Nikitsy | 18—23 VII | 32 | 4307 | 135 | 80.7 | 575 | 18 | 10.7 | 7 | 0.2 | 0.1 | 12 | 0.4 | 0.2 | 462 | 14.1 | 8.3 | 5363 |
| Totals . . . . . | | 95 | 5360 | 56.4 | 74.3 | 1175 | 12.3 | 16.2 | 131 | 1.4 | 2.0 | 45 | 0.5 | 1 | 515 | 5.4 | 6.5 | 7226 |

TABLE 2. Relationships between Species of Mosquitoes, Heleids, and Tabanids Found at Different Localities

| Species of insect | Taiga zone | | Forest-tundra zone | | Totals |
|---|---|---|---|---|---|
| | Pechora | Ust'-Tsil'ma | Nar'yan-Mar | Nikitsy | |
| **Mosquitoes** | | | | | |
| *Aëdes punctor* Kirby | 131 | 232 | 188 | 2294 | 2845 |
| *A. excrucians* Walk | 77 | — | 103 | 1065 | 1245 |
| *A. communis* Deg. | 46 | 84 | — | 948 | 1078 |
| *A. dianteus* H. D. K. | 12 | — | — | — | 12 |
| *A. maculatus* Mg. | 10 | — | — | — | 10 |
| *Theobaldia alaskaensis* Ludl. | 10 | 159 | — | — | 169 |
| *Anopheles maculipennis* Mg. | 1 | — | — | — | 1 |
| **Heleids** | | | | | |
| *Culicoides pulicaris* L. | 4 | 108 | — | 3 | 115 |
| *C. riethi* Kieff. aff. | — | — | — | 4 | 4 |
| *C. grisescens* Edw. | — | 12 | — | — | 12 |
| **Tabanids** | | | | | |
| *Tabanus tarandinus* L. | 1 | — | — | — | 1 |
| *T. borealis* Mg. | — | 3 | 4 | 7 | 14 |
| *T. laponicus* Wahlb. | — | 1 | — | — | 1 |
| *T. luridus* Flln. | 12 | 1 | — | — | 13 |
| *T. confinis* Ztt. | — | — | — | 1 | 1 |
| *Chrysops relictus* Mg. | 10 | — | — | — | 10 |
| *Chrysozona crassicornis* Wahlb. | — | 1 | — | 2 | 3 |
| *Ch. pluvialis* L. | — | — | — | 2 | 2 |

Black-flies (Simuliidae). At the end of July and beginning of August, that is to say, during the time of their prevailing flight, the black-flies comprised 88% of the over-all number of bloodsucking Diptera attacking man. In the collected material the black-flies were represented by two species in large numbers: Simulium pusillum Fries and S. tuberosum Lundstr.

The flight of black-flies began in the beginning of July and terminated in August with the onset of frosts. Their most intensive activity in 1955 was observed during the third ten-day period of July and at the beginning of August, with an absolute frequency of attack on man of up to 249 specimens in five minutes. Black-fly attack activity was displayed around the clock, with continuous solar illumination, with a maximum during the second half of the day and a minimum toward the night-time. We observed the highest degree of black-fly activity to occur at an optimal temperature of 14 to 23°C with a maximum at 17-20°C. A wind velocity of more than 2 m/sec under taiga conditions stopped the attacks of black-flies, while in the forest-tundra their flight was still observed when it was 4 m/sec. The black-flies were particularly active before rains.

Heleids (Heleidae). The proportion of heleids during the period of investigation was 0.1 to 16.7% of the over-all number of bloodsucking Diptera attacking man, with more attacks on man in the taiga zone than in the forest-tundra.

In our material the heleids were represented by three species: Culicoides pulicaris, C. grisescens, and C. riethi aff. The most numerous species, as may be seen from Table 2, was C. pulicaris.

The heleids are most active in the evening. However, when the sun does not set they also attack during the day. The optimal temperature conditions for heleid activity were observed to be between 11 and 18°C. With a wind velocity of more than 1-1.5 m/sec, mass attacks were not recorded. The forest-tundra specimens were distinguished by a somewhat greater wind-resistance than the taiga ones. A considerable prevalence of heleids was observed at the end of July and the beginning of August. Their flight terminates together with that of the black-flies with the first frosts in August. The greatest absolute frequency of attack by heleids on man in five minutes was 48 specimens.

Horse-flies (Tabanidae). At the localities investigated we found eight species of horse-flies of three genera: Tabanus, Chrysops, and Chrysonzona. For the species of horse-flies found at the various points one may refer to Table 2. The most numerous species proved to be T. borealis, T. luridus, and Ch. relictus. The taiga zone was predominant in numbers of horse-flies.

In 1955 the absolute frequency of horse-flies was insignificant. The horse-flies made up no more than 0.2-7.2% of the over-all number of insects attacking man. Solitary attacks on persons were recorded, primarily by representatives of the genus Chrysops.

Flight of horse-flies was observed from the beginning of July, with a maximum frequency in the second ten days of July and a distinct reduction toward the beginning

of August. The horse-flies are diurnal bloodsuckers, butt in the north, where the sun does not set, their flight continues throughout most of the 24-hour cycle, reaching its maximum at 1300-1600 hrs and becoming reduced toward night. Intensive flights by horse-flies were observed on warm and sunny days at temperatures of 15 to 26°C and at wind velocities of up to 4 m/sec.

Muscids (Hydrotae dentipes F.). The flies of this species are not bloodsuckers and do not enter into the composition of the bloodsucking Diptera fauna, but during our observations, especially near the village of Nikitsy, they alighted on man and animals in a troublesome manner together with other insects, getting into the eyes, ears, nose, and mouth, which caused us to turn our attention to them.

Their numerical proportion in relation to the over-all number of bloodsucking Diptera attacking man reached 12%. Their activity was observed around the clock with the maximum at mid-day at a temperature of 12 to 26°C and a wind velocity of 4 m/sec. The absolute frequency of attack on man in five minutes was as high as 68 specimens. They only attacked under an open sky, never flying into a house. The seasonal spread of their flight varied within broad limits – from the beginning of June to the middle of August. It should be pointed out that, particularly during the morning, we could observe a persistent and distinct coloration of the dorsum of these flies with a yellow bloom from the pollen of some kind of flower.

## CONCLUSIONS

1. Through an expeditionary investigation of localities along the Pechora River (Pechora and Ust'-Tsil'ma in the Komi ASSR, Nar'yan-Mar and Nikitsy in the Nenets National Region) in the period from June 28 to August 10, 1955, representatives of the following groups of bloodsucking Diptera were found: Culicidae, Simuliidae, Culicoides, Tabanidae, and the muscid Hydrotaea dentipes F.

2. The mosquitoes collected represented seven species: Aedes punctor Kirby, A. excrucians Walk., A. communis Deg., A. dianteus H.D.K., A. maculatus Mg., Theobaldia alaskaensis Ludl., and Anopheles maculipennis Mg. Numerically dominant were A. punctor Kirby, A. excrucians Walk., and A. communis Deg.

The horse-flies collected belonged to eight species: Tabanus tarandinus L., T. borealis Mg., P. lapponicus Wahlb., T. luridus Fiin., T. confinis Ztt., Chrysops relictus Mg., Chrysozona crassicornis Wahlb., and Ch. pluvialis L.

Two species of black-flies were recorded: Simulium pusillum Fries and S. tuberosum Lundstr.

The heleids collected belonged to three species: Culicoides pulicaris L., C. grisescens Edw., and G. riethi Kieff. aff. C. pulicaris L. predominates in numbers.

3. Of the Diptera complex as a whole the mosquitoes attacked in the greatest numbers in 1955 (74.3%), then came the black-flies (16.2%), the muscids (6.5%), and the heleids (2%), with the tabanids attacking individually. The absolute frequency of attack by Diptera on man was as high as 700-950 individuals in five minutes.

4. The season of appearance of bloodsucking Diptera in the north, in 1955, began in the middle of June with the emergence of mosquitoes, which increased in numbers to the middle of July. At that time they were joined by horse-flies. In the third ten-day period of July the number of mosquitoes and horse-flies began to decrease, but masses of black-flies and heleids appeared; these then ended their season in August with the onset of frosts.

5. In the summer of 1955 active attacks by bloodsucking Diptera were observed to occur at temperatures of 11 to 26°C. Since the sun did not set, the insects were active around the clock with attack maxima in the morning, at noon, and especially in the evening and a minimum at night.

A wind velocity of more than 2 m/sec in the taiga and 4 m/sec in the forest-tundra almost completely stopped the flight of heleids, mosquitoes, and black-flies while it had no great effect on tabanids and muscids. The forest-tundra species of bloodsucking Diptera are more wind-resistant than the taiga species.

6. Atmospheric pressures of 748-765 mm and a relative humidity of 63 to 100% did not seem to have any noticeable effect on insect activity, according to our observations.

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# ON A NEW GENUS OF MAY-FLIES (EPHEMEROPTERA, BEHNINGIIDAE)*

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Until recently the family Behningiidae has included only the single genus Behningia Lestage, 1929. The type of this genus is Behningia ulmeri Lestage, 1929, established and named from a detailed description, made by Ulmer (1924), of a larva from the Volga. Fourteen years later a second species of the genus was described, also from the larva, collected in this case in the Dnestr, and named Behningia lestagei Mot. et Bâc. (Motas and Bâcesco, 1938); the describers of this species expressed the opinion that the genus Behningia belonged to a separate family Behningiidae. Simultaneously with the paper by the Rumanian authors, new material in the Behningiidae was described in the USSR from the Amur- one larva and, particularly important, two adult specimens (males). The description of this Far Eastern material demonstrated the unique structure of Behningia, not only of the larva but of the imago; on this basis the separate family Behningiidae was established (Chernova, 1938). In 1955 cast skins of Behningia larvae and adult females were found in Poland, in the Warta (Keffermüller, 1957). In recent years some larvae and, in addition, some adult females were once again collected in the Amur. The data enumerated here point to the scarcity of this group of may-flies and also demonstrate its extremely wide distribution.

The description of the new family Behningiidae has aroused some comment in the literature. The structure of Behningia, its phylogenetic relationships, and its position in the classification of the Ephemeroptera have been discussed. For instance, Lestage (1938) stated that a separate family should not be established for this genus and that Behningia belongs to the true Oligoneuriidae. Motas and Bâcesco (1940), in a later work, joined in this opinion stating that the family Oligoneuriidae should be divided into two subfamilies – the Oligoneuriinae and Behningiinae. Demoulin (1952, 1955) accepted the Behningiidae as a separate family and discussed its close relationship to the Palingeniidae and Oligoneuriidae. In his latest system of classification Demoulin places the Behningiidae in the superfamily Palingenioidea which includes, in addition, the modern Palingeniidae and the extinct Jurassic Mesephemeridae (Demoulin, 1958). Thus, he no longer considers our family to be close to the Oligoneuriidae.

Very recently we received the new work of Edmunds and Traver (1959), in which the authors examine all the members of the Behningiidae known to date and describe a new genus Dolania from larvae collected in the southeastern United States, in the Savannah River. In addition, in this paper Edmunds and Traver discuss the question of the systemetic position of the Behningiidae in the order, placing it in the superfamily Ephemeroidea. We believe their conclusion to be nearer to the truth.

The new, third genus described below differs considerably from both Behningia and Dolania; for this reason the characterization of the family on the basis of the larval phase should be correspondingly changed.

## Protobehningia Chernova, gen. nov.

Larva. Body very narrow and of almost constant width throughout; length of body 7 times width of mesothorax. Anterior end short; abdomen 3 ½ times longer than head and thorax combined (Fig. 1). Head rounded, retracted, enclosed almost halfway by sides of prothorax; ocelli lying anterior to compound eyes. Labrum thin and short; more developed mandibles with strongly sclerotized margins and dentate; grinding surface absent on inner margin; between outer teeth and inner process is a bifurcate process with sharp teeth (Fig. 2, a,b); maxillary lobe extended, narrowing apically and terminating in a sharp tooth; maxillary palp three-segmented (Fig. 2, c); hypopharynx trilobate, outer margin of its median lobe excavate; labium small and with well-developed inner and outer lobes separated from one another; labial palp three-segmented, the division between 2nd and 3rd segments very indistinct and visible only in microscopical preparations (Fig. 2, d). Anterior legs located as in Behningia, laterally to labium as "gnathopeds" applied closely to head; middle and hind legs of similar structure, but very short; no compact or widened hind legs; claws present on all pairs of legs; coxae strongly developed on all legs (Fig. 2, e, f, g). All abdominal segments long and narrow, convex, their lateral margins with flat projections possessing even outer margins; all gill filaments plumose; the first pair single, the remaining six pairs double; gills held

*In the composition of this paper the work was shared in the following manner between the authors: the collaborator from the Pacific Institute of Fisheries and Oceanography, O. Ya. Baikova, collected the material, studied the habitat, and established the family relationships of the species; O. A. Chernova described the genus and species.

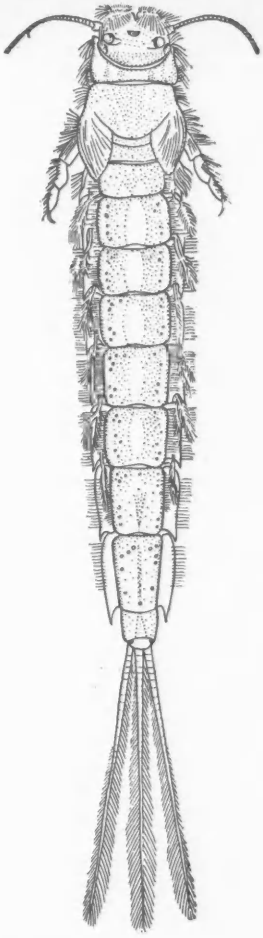

Fig. 1. Protobehningia asiatica, g. n., sp. n., larva from above. (Figure by O. A. Chernova).

along abdomen; setae situated in a straight line along sides of all abdominal tergites where a break occurs between dorsal and lateral surfaces of tergites; caudal filaments (cerci and paracerci) equal in length.

Imago. The winged phase is unknown, but it is possible to gain an idea of it from the rudimentary wings of the larva, which display numerous transverse and separated longitudinal veins (Fig. 3); the branching point of M is located almost at the base of the wing, proximally to the branching point of RS, this being characteristic of Behningia and Dolania*; on the basis of an interpretation of venation given by Demoulin (1952) it may be noted that in the forewing MA branches off at the same level as MP, the basal parts of the veins situated behind MP are not visible, and the intercalary veins between CuA and CuP are 8 in number and connected together by cross-veins; the hind wing is well developed, with SC and R proceeding parallel to the apex, and RS being four-branched; basal sections of other veins are not visible behind the basal part of R; the median and distal sections of, apparently, the three medial branches and CuA are distinctly visible; there are few distinct cross-veins in the hind wing; the anal field of both wings consists of large cells.

Type of genus: Protobehningia asiatica, sp. n.

Composition and distribution of the genus. One species, the type of the genus, found in the lower reaches of the Ussuri River.

## Protobehningia asiatica Chernova, sp. n.

Larva. Outgrowths of anterior margin of head not projecting laterally, covered with blunt bristles; lateral margin of head with very small impression at level of antennae; bases of antennae ventral, 1st segment not visible from above, the long 2nd segment projects beyond lateral margin of head; labium extending along entire anterior margin of head, its anterior margin provided with long setae; mandibles strong asymmetrical – apex of inner projection of right mandible strongly drawn out; inner margin of maxilla bearing a row of long bristles and a row of stout, shorter spinose bristles; at base of apical tooth there is an additional small tooth; division between 2nd and 3rd maxillary papal segments visible only in microscopical preparations; palpiger well developed; inner and outer lobes of labium almost equal in size; almost entire surface of labial palp covered with rows of long bristles; most bristles are equally thick for their entire length and have a blunt apex; longest bristles are found at base of 1st palpal segment; these bristles are pale and seen best of all in transmitted light. Anterior margin of prothorax strongly concave, the anterior angles reaching upper parts of compound eyes, their lateral surfaces bearing long bristles. Anterior leg flattened, with a large coxa and broad, flat femur, on which long bristles are arranged; tibia and tarsus fused; the margins between these sections may be made out on comparison with the middle and hind legs; furthermore there is a row of bristles at this point in dorsal view; inner margin of anterior legs bearing short bristles; middle and hind legs with a distinctly articulated tarsus; claw of third pair of legs strongest, acute and curved; hind legs especially strongly armed with sharp strong spines similar to the thorns of plants. Abdominal segments above lateral projections strongly flattened laterally, the gill filaments with their flat surfaces applied

* We noted a similar venation characteristic in one species of Asthenopus (Campsurinae) from S. America (Demoulin, 1955: 29).

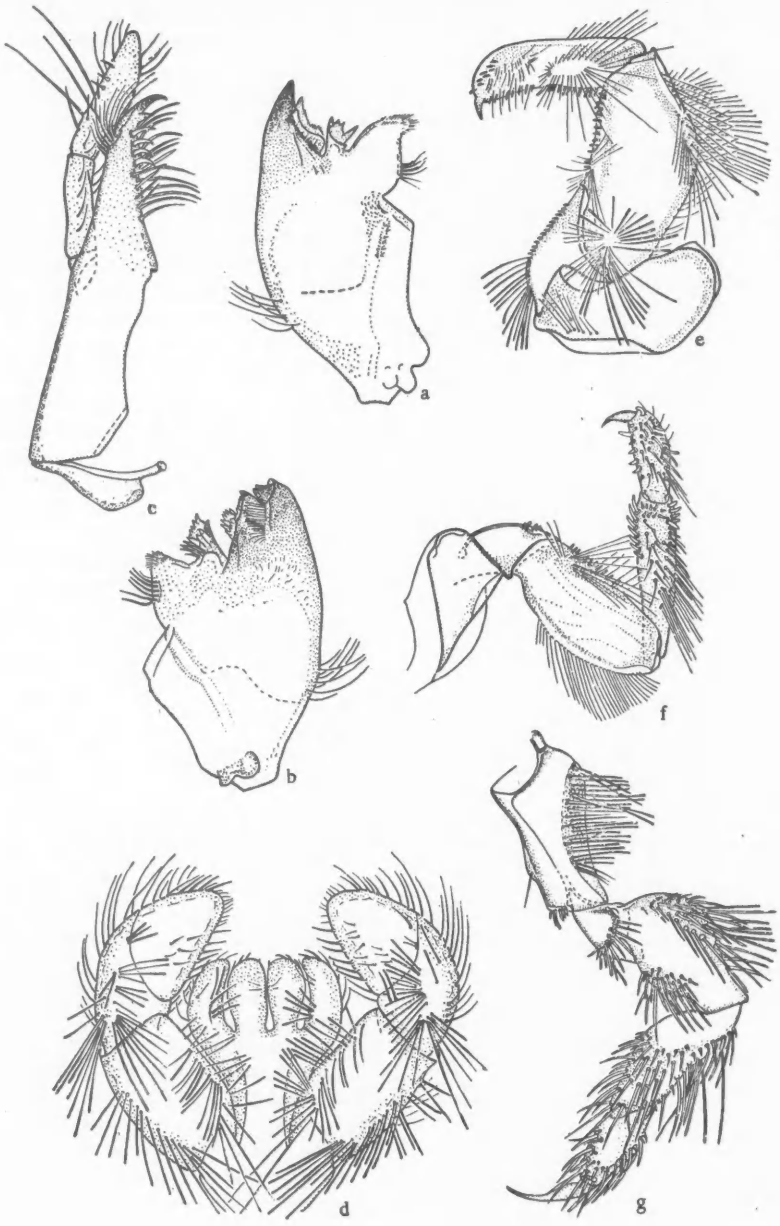


Fig. 2. Protobehningia asiatica, g. n., sp. n. a) Right mandible from below; b) left mandible from below; c) maxilla from below; d) labium from below; e) fore-leg from below; f) middle leg from below; g) hind leg from below. (Figures by O. A. Chernova).

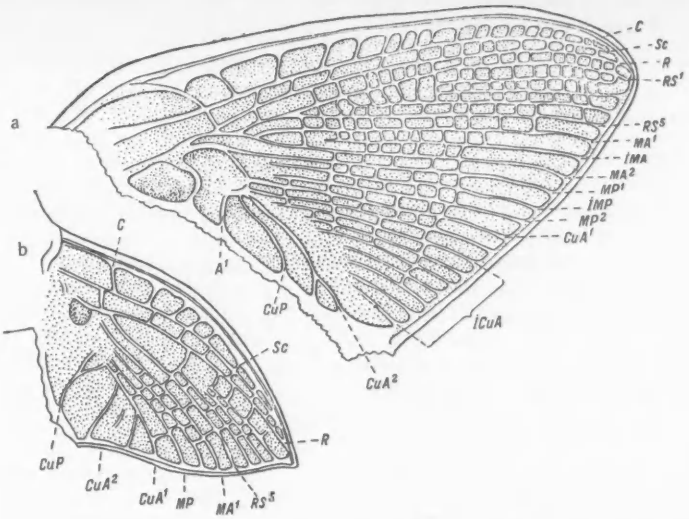


Fig. 3. Protobehningia asiatica, g. n., sp. n., rudiments of fore and hind wings of larva. (Figures by O. A. Chernova).

against these raised sides in such a manner that in dorsal view the sides of the gill filaments are visible; upper branch of each gill shorter than lower one; first gill filament single, its base formed like a short, broad handle from which emerge a plumose rod and long filaments arranged along sides of this handle. Each caudal filament fringed with setae which are shorter at basal part of filament; paracercus is most heavily fringed, the setae distributed on either side; cerci are fringed on inner side, their outer side bearing setae only on apical part; segmentation of caudal filaments barely perceptible.

Coloration of larva pale, uniformly pale yellow, the abdomen lighter below; the black eyes and ocelli and distinct, reddish-golden tufts of setae on anterior margin sharply stand out on pale head; margins of abdominal tergites somewhat darker where setae are located; surface of each tergite in addition with a row of very minute round spots devoid of pigment; on lower surface the reddish-golden spines on legs are the most brightly colored; setae on abdomen pale. Caudal filaments and their setae white

Length of not fully grown larvae 12.5 and 14 mm; length of caudal filaments 5.5 and 6 mm.

Material. Lower course of the Ussuri River, July 10 (2 larvae) and 11 (1 larva), 1958, collected by O. Ya. Baikova. The type of the species is preserved in the collection of the Zoological Institute of the Academy of Sciences, USSR, in Leningrad.

Ecology. Two larvae were caught in a plankton net at a depth of 6 m and a water temperature of 21.5°C; the third larva was caught at the surface of the water. In the gut of one of the larvae were found antennae and seta tufts of copepod crustaceans, the head of a tentipedid larva, and a few filamentous algae; there was no plant debris. These data (together with the absence of grinding areas on the mandibles[1]) enable us to suppose that the larvae of Protobehningia are predatory. The unique structure of the legs, which are short, bent, and provided with spines, is clearly unsuitable for swimming purposes.

Until recently the way of life and ecology of Behningiidae larvae remained poorly known. In their work Edmunds and Traver (1959) first reported accurate observations on the behavior of live larvae. It appears that these larvae have the ability to burrow quickly into sand, the large anterior projections on the head, provided with strong bristles, serving as the principal organ by means of which the larva sinks into the substrate; the elongated maxillary and labial palps and the anterior pair of legs are then directed forward and help in the digging. All these data were obtained through direct observations of live larvae placed in a glass vessel with water and sand. Our previous assumption concerning the nectonic way of life of Behningia larvae was based on the structure of the hind legs, which are flattened and partly paddle-shaped, and also on indirect evidence (the collection of larvae in deep water with a plankton net). In the larvae of Dolania americana similar hind legs serve as coverings for the gills when moving through sand. The structure of the legs of Protobehningia asiatica Chern., sp. n., fully supports the idea of a burrowing way of life in deep sand; this is indicated not only by the presence of strong, bristle-bearing projections on the head but especially by the long, smooth, worm-like body and strong, bristle-bearing legs. It should also be pointed out that the expansion of the abdominal tergites and the formation of a unique lateral groove on the abdomen, in which the gills are located, are also excellent adaptations for the movement of the larva within sand. The

predatory way of life (the most probable food are tendipedid larvae) also fully accords with a habitat in sandy bottoms.

## KEY TO THE GENERA BASED ON THE LARVAE

1 (2). Total length seven times width; very narrow, abdominal segments long; middle and hind legs short, not reaching beyond end of second abdominal segment; all legs bearing claws; gill filaments located at sides of abdomen . . . . . Protobehningia, gen. nov.

2 (1). Total length almost three times width (at mesothorax); abdominal segments short and broad; hind legs long, reaching almost to ninth abdominal segment; all legs devoid of claws; gill filaments located on venter of abdomen . . . . . 3.

3 (4). Hind coxae approximately half as long as femora; outer surface of hind femur with dense hair-like bristles; outer margin of mandibles weakly rounded; paraglossae long and narrow, considerably longer than wide . . . . . Behningia Lestage.

4 (3). Hind coxae about 4/5 as long as femora; outer surface of hind with sparse bristles; outer margin of mandibles sharply angular; paraglossae short and broad, wider than long . . . . . Dolania Edmunds and Traver.

## SUMMARY

In 1958, in the lower reaches of the Ussuri River, the junior writer found three larvae of a remarkable may-fly which belongs to an unknown genus of Behningiidae. Its differences from the other genera are given above in the key.

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# A NEW SPECIES OF THE GENUS KYTORRHINUS FISCH. (COLEOPTERA, BRUCHIDAE) FROM THE MARITIME TERRITORY

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Translated from Éntomologicheskoe Obozrenie, Vol. 39, No. 2, p. 417, April-June, 1960.

Among a small amount of material which V. N. Lyubarskaya sent to me for identification from the Maritime Territory there was a new species of bruchid of the genus Kytorrhinus Fisch., the description of which is given below.

Kytorrhinus caraganae Ter-Minassian, sp.n.

Entirely black, invested with sparse, short, recumbent golden hairs. Head elongate, projecting forward, demarcated by a carina extending from the base of the antennae to the labrum; a cruciform line on the frons clearly marks off the hind margin of the clypeus; frons between eyes distinctly convex; eyes moderately convex with deep emargination; antennae in ♂ reaching apical third of elytra, distinctly pectinate, black. Pronotum at base not less than one-and-a-half times broader than long, converging strongly anterad; fore margin of pronotum not broader than half its base. Base of pronotum with semicircular lobe on dorsum of which there is a long depression dividing this lobe into two parts; the depression is covered with a patch of white hairs. On both sides of this lobe the basal margin of the pronotum is sinuate. On dorsum of hind angles of pronotum there is a distinct depression; center of pronotal disk is clearly convex; entire pronotum densely and finely punctate. Scutellum elongate with a weakly emarginate apex. Elytra no more than a quarter longer than their total width at base, with distinct general convexity behind scutellum, the last three tergites exposed. Elytra covered with regular rows of narrow striae, with no punctures distinguishable in these. Intervals between striae broad, much broader than striae themselves, flat, uniformly and densely covered with a fine reticulate sculpturing, without punctures. Pygidium convex in center, barely longer than width at base, finely punctate. Legs slender, long, hind femora stouter than others; venter and legs uniformly finely punctate. Length 4 mm.

Maritime Territory, Maikhinskii Forestry, September, 1955. Bred out from seeds of the pea-tree (Caragana arborescens L.), 2 ♂♂ (in type the left antenna is broken off).

Type in collection of Zoological Institute, Academy of Sciences, USSR, in Leningrad.

This species is close to Kytorrhinus senilis Solsky but is easily distinguished from it by the much finer punctuation of the pronotum, the absence of large punctures on the elytral intervals, the exposed tergites, the pygidium and venter of the body.

# THE CADDISFLY Apatania zonella Zett. (TRICHOPTERA, LIMNOPHILIDAE) IN KHABAROVSK PROVINCE

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Translated from Entomologisheskoe Obozrenie Vol. 39, No. 2, pp. 418-423, April-June, 1960

For a long time it was thought that this fairly widely distributed species had a purely parthenogenetic life cycle, since it was believed that the males were unknown (see, for instance, Martynov [1924], p. 351). In fact, the male of A. zonella Zett. had been described as early as 1893 (Sahlberg [1893], p. 18, Figs. 1-2) under the name of A. palmeni from one specimen from Kola Peninsula.

Siltala [1908a] (pp. 10-11, Table II, Fig. 4), [1908b] (pp. 19-21) gave the first good figures of the male of this species under the name A. palmeni Sahlb., and a little later described the female larvae and pupae of A. zonella Zett. (under the name Apatania arctica Bohem.).

Mosely [1930] (pp. 237-239, Figs. 1-3), without referring to Siltala's work [1908a], again described the male of A. zonella Zett. as A. arctica Bohem.; in the following year the same author (Mosely [1931], p. 34) suggested that the male described in detail and figured by Siltala as A. palmeni Sahlb. (Siltala [1908a], pp. 10-11, Fig. 4) belonged to the species A. arctica Bohem.

Finally, in Schmid's comprehensive monograph [1954] (pp. 30-34, Figs. 67-69) on the subfamily Apatanilinae, the male and female of A. zonella Zett. were again described, together with a full synonymy of the species and with good clear figures; the names A. palmeni Sahlb. and A. arctica Bohem. were reduced to synonyms. Schmid indicated and substantiated the existence of two subspecies of A. zonella Zett. and noted the wide distribution of the species in the northern part of Eurasia, from the extreme west (Scandinavia, Greenland) to Kamchatka in the east, and also in Canada. Schmid casts doubt on authors' records of A. zonella being found in Turkestan, the Altai and Mongolia; he points out that males of this species are very rare (1:150-200) In his opinion, parthenogenetic reproduction is possible.

An acquaintance with the above-mentioned work led me to the conclusion that the Apatania which I found in several spring waters in Khabarovsk Province belongs to the species A. zonella Zett. The interest of this find lies not only in the confirmation of the occurrence of this species in relatively southern regions, but also in the distinctive features of its biology, since in the waters of Khabarovsk Province the ratio of the sexes in A. zonella Zett. was found to be normal.

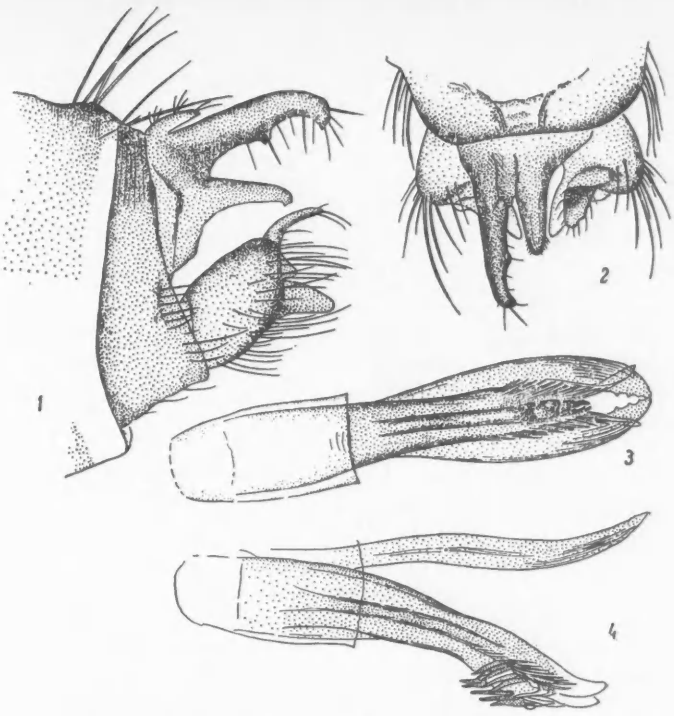
Drawings of the male genitalia (Figs. 1-4) and a comparison of them with Schmid's figures indicate that our insects belong to the subspecies A. zonella zonella Schmid. In the strucutre of the male genitalia there are no essential differences between the Far Eastern specimens and those figured by Schmid, if we ignore the fact that segment IX is much narrower laterally. The titillators in Schmid's figures are certainly a little longer than in our specimens (Figs. 3-4). However, in Siltala's figures [1908a] (Table II, Fig. 4) the proportions of the penis and titillators are the same as in our specimens, so that this character is probably variable.

Greater differences are found in the genital structures of the female (Figs. 5-7). However, as Schmid points out, the structure of the genitalia in female A. zonella is much more variable than that of the males. This holds also for the Far Eastern representatives of the species. One of the variations in the strucutre of the last abdominal segments of the male is shown in Fig. 5. The size both of males and females varies considerably.

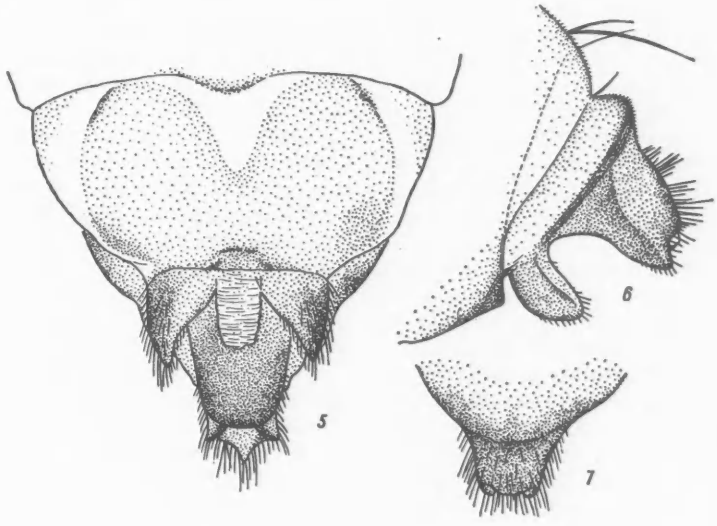
The larvae of A. zonella zonella from the waters of Khabarovsk Province do not differ essentially from Siltala's description [1908a]. Our specimens were distinguished by their slightly larger size (8-10 mm long, 1.8-2.2 mm broad) and the greater profusion of gills in the dorsal rows. Unfortunately, Siltala gave no figures of the larva, and hence I consider it relevant to give an illustration of the dorsum of the first two thoracic segments of the A. zonella larva (Fig. 8). The dark figure on the pronotum may be expressed in very varied degree, and can occupy a large or small part of the pale surface of the tergite; the lateral parts of the figure may be absent. The tergite of the mesonotum is darker; in light-colored specimens the dark figure does not spread on to the fore angles of the tergite or on to its hind part; the large dark patches on the hind angles of the mesonotum have a pale spot in the hind half.

| | Gills | |
|---|---|---|
| Segments | Dorsal rows | Ventral rows |
| I ..... | 0 — 1 | – |
| II ..... | 2 — 1 | 0 – 1 |
| III ..... | 2 — 1 | 0 – 1 |
| IV ..... | 1(2) — 1 | 0 – 1 |
| V ..... | 0 — 1 | 0 – 1 |
| VI ..... | 0 — 1 (0) | 0 – 1 |

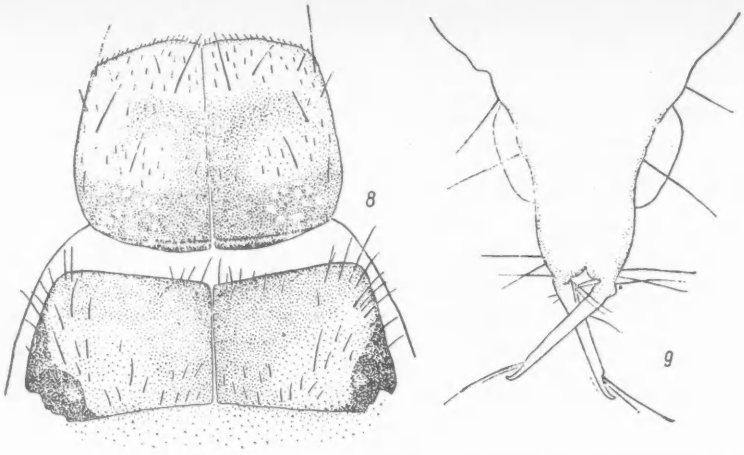
The tergite of segment IX is trapeziform. Apart from the two stout and long median setae there are another




Figs. 1-4. Apatania zonella zonella Zett. Male. 1) Genitalia, lateral aspect; 2) genitalia, dorsal aspect; 3) penis, dorsal aspect; 4) penis, lateral aspect.




Figs. 5-7. Apatania zonella zonella Zett. Female. 5) Hind end of abdomen, ventral aspect; 6) the same, lateral aspect; 7) the same, dorsal aspect.




Figs. 8-9. Apatania zonella zonella Zett. 8) Pro- and mesonotum of larva; 9) anal appendages of female pupa, dorsal aspect.

30-32 medium and small setae situated in the hind third of the tergite.

The pupae vary considerably in size, the length of the male varying from 6.3-9.5 mm, the female from 6.5 to 9.0 mm; the majority of individuals are from 7 to 8 mm long (♂ ♀). Fig. 9 illustrates the anal processes of the female pupa in dorsal aspect.

The larvae and pupae live in cold waters – brooks, springs and in small lakes of spring origin. In L. Teploe the larvae mainly colonize the biotope of benthic filamentous algae (Rhizoclonium sp.), their numbers here reaching 19,000 individuals per 1 $m^2$, which amounts to more than 32 $g/m^2$. The summer temperature of the water does not exceed 12°C, and in winter varies between 0 and +3°C. In the small river flowing out of the lake, where the water temperature in summer rises to 17°C in places, the A. zonella larvae inhabit areas with slower current, on silted pebbles, among growths of algae and water moss, and also in the mat of algae floating at the surface. The guts of the A. zonella larvae were packed with filamentous algae and epiphytic diatoms.

A. zonella is an important constituent of the food of fry of the autumn keta salmon, which feeds in these waters, and also of several other freshwater fish. The keta fry feed mainly on the pupae of this species during their ascent to the surface of the water before transformation into the adult. The grayling feeds extensively on both the larvae and pupae together with their cases, as well as on the adult insects flying over the water. The larvae and pupae are also eaten by the lenok (Brachymystax lenok Pall.), the Amur ide (Leuciscus waleckii [Dybowski]) and other fishes.

The emergence of adult A. zonella begins in late May and continues till late Autumn. Emergence is at its height in July - August. In the waters mentioned the reproduction of A. zonella is normal. The numbers of males and females during the flight period are approximately the same. The one thing we noted was a considerable variation in size, particularly in the females. The development from egg to imago in the waters of Khabarovsk Province takes two years.

Martynov [1930] (pp. 79-80) believed that A. zonella was indigenous to the mountain localities of Central Asia – Turkestan, the Altai, Khangai Mts., and South Ussuri Province. From there, in his opinion, this species spread during the Ice Age into the valleys, to the far North, where it changed over from a life in rivers to a life in cold lakes. In his earlier work [1914] (p. 48) Martynov stated that, since the nature of reproduction is related to external conditions, we might expect to find A. zonella males in other regions (in Mongolia, in particular). As we now know, the males of this species can be found even in the west, but in a proportion of 1:150-200 of females. In Central Asia and the Altai we found only females, with the southern individuals being distinguished by their smaller size. This latter fact, in my opinion, indicates that northeast Asia must be regarded as the center of formation of the species. This suggestion is supported by the normal ratio of the sexes in the population and the large size of the insects in Khabarovsk Province.

It seems a strange fact that Martynov [1935] (pp. 323-324) had only females of A. zonella from Ussuri Province. In this connection it must be noted that in the cold springs of Khabarovsk Province I found another species of Apatania, which was first erroneously identified as A. zonella and was figured under this name in a short note (Levanidova [1950] [pp. 166-167]) on the parthenogenetic development of this species.

Here we were really dealing with a truly parthenogenetic mode of reproduction, since I collected and examined hundreds of pupa and did not find a single male. From the pupae more than ten females were bred out,

and one of these laid eggs in the aquarium; I followed the development of the larvae from the eggs. Both the imago and the larva of this species differed distinctly from those of A. zonella; in the structure of the genitalia this form could evidently not be assigned to any of the species figured in Schmid's work. It is possible that this is a new species, but it is also probable that it is the hitherto unknown female of one of the species, described only from males, of the Japanese - Chinese fauna.

In analogy with the peculiar features of the reproduction of A. zonella in different geographical regions, it can be suggested that for this other Apatania species, Khabarovsk Province lies outside the limits of the original localities of the species, and in these new conditions there has been a change from a bisexual mode of reproduction to a parthenogenetic one.

It seems very probable to me that even in those European species known only from females, such as A. hispida Forssl., A. muliebris MacLach. and certain others, the males will be found in time, in eastern, less well-investigated countries of the world.

## SUMMARY

For a long time the opinion prevailed that the species in question reproduced solely by parthenogenesis, though Sahlberg [1893] (p. 18, Figs. 1,2) had already described a male Apatania zonella Zett. from a specimen from Kola Pen., and had named it A. palmeni.

The first good figures of this species were given by Siltala [1908] (pp. 10-11, Table II, Fig. 4) under the same name; the female larvae and pupae were also described by him under the name A. arctica (Siltala [1908a], pp. 19-21). The male of this species was described again by Mosely [1930] (pp. 237-239, Figs. 1-3) under the name Apatania arctica Bohem. The identity of the earlier known female of Apatania arctica Bohem. and of the male, which was described under the name A. palmeni Sahlb., was first suggested by Mosely [1931] (p. 34).

The most recent description of the species Apatania zonella (♂ ♀) is found in Schmid's comprehensive monograph, where Apatania palmeni Sahlb. and A. arctica Bohem. are designated as synonyms of the above-mentioned species (Schmid [1954], pp. 30-34, Figs. 67-69). According to Schmid, the males of this species are rare; the reproduction of A. zonella, in his opinion, is also parthenogenetic in many cases.

The Apatania which I collected in the springs of Khabarovsk Province (Figs. 1-4) belongs to the species Apatania zonella Zett., subsp. zonella Schmid.

According to Martynov [1930] (pp. 79-80) the original habitat of A. zonella is to be sought in the mountain region of Central Asia (Turkestan, the Altai, Khangai Mts. and South Ussuri Province). In an earlier work of Martynov [1914] (p. 48) we find the suggestion that the male A. zonella might be found in other regions also, for instance, in Mongolia. It has recently been established that the male of this species occurs also in the west, though in proportion 1:150-200 of females.

Only females were found in Central Asia and in the Altai, the southern specimens having a smaller body size. This last fact gives grounds for the suggestion that the center of origin of this species was in northeast Asia. This suggestion is supported by the size and normal sex ratio of the A. zonella specimens found in this region.

The A. zonella which I referred to earlier (Levanidova [1950], p. 166) from other localities of Khabarovsk Province was found after thorough examination to be another species, the reproduction of which is parthenogenetic in this locality.

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# NEW AND LITTLE-KNOWN MEGACHILID BEES (HYMENOPTERA) FROM CENTRAL ASIA

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Translated from Entomologicheskoe Obozrenie Vol. 39, No. 2, pp. 424-437, April-June, 1960

This paper consists of a description of two species belonging to the genus Heriades and one species of the genus Hoplotis within the subgenus Acanthosmia; there is also included a description of the hitherto unknown female belonging to another species of Acanthosmia together with a redescription of the male. Osmia difficilis F. Mor. has been established as synonymous with O. falcata F. Mor.

The whole of the material, including the type specimens of the new species, is preserved in the collection of the Zoological Institute, Academy of Sciences, USSR.

## Heriades longicornis Popov, sp. n.

Female: Length 4.5 mm. Head (Fig. 1) large, noticeably wider than the trunk, and rather longer than it is wide, rounded and somewhat depressed. Width of frons equal to that of the eyes. Eyes broadly rounded, barely twice as long as their maximum width, directed slightly toward the mandibles. Ocelli arranged at the apices of an equilateral triangle. Distance between the median and lateral ocelli equal to their diameters. Distance from the lateral ocellus to the edge of the vertex somewhat greater than the diameter of the ocellus. Mandibles rather short and broad, tridentate; terminal tooth elongate, internal tooth short; keels well developed over the whole mandibles but less distinct at the base, where they are widely separated. Maxillary palp very short, 4-jointed, the joints being of almost equal size, 4th joint slender. Clypeus convex, its breadth almost twice its length, and its margin almost straight except for a faint median notch. Submentum broad, almost flat. Antennae short, barely reaching the scutum; scape short, four times as long as its greatest width at the base; first segment of the antennal flagellum markedly thickened and rounded, approximately 1½ times as long as broad; segments 2-4 distinctly shorter than they are long, depressed at their apices. Lateral parts of pronotum compressed with lamellate anterior margins. Scutum tall with a vertical anterior surface which is continuous with the posterior margin of pronotum. Parapsids barely noticeable, linear and almost equal in length with the squamae. Scutellum without lateral teeth, almost flat, one and a half times as long as the scutum. Postnotum short, twice as long as the horizontal portion of the intermediate segment. Horizontal portion of intermediate segment sharply delimited, longitudinally reticulate. Central field of intermediate segment not delimited. Abdominal tergites without any depressions; transverse keel at the boundary between vertical and horizontal portions of first tergite clearly expressed over its whole length. Sixth tergite elongate and depressed at its rounded end. First segment of posterior tarsus four times as long as broad, almost parallel-sided, segments 2-4 a little longer than their greatest width just in front of the posterior edge.

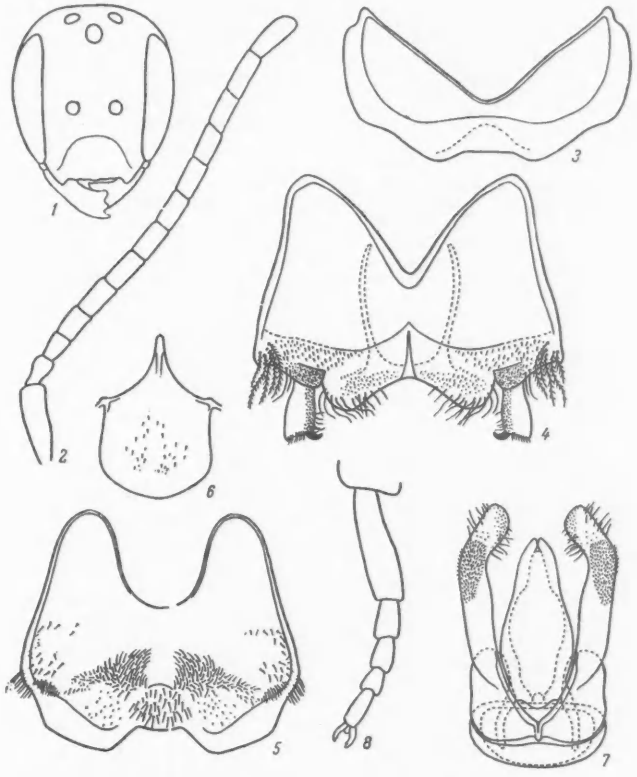
Head glossy with rather coarse speckling. Speckling on clypeus rather more delicate and less abundant, the intervals between separate spots being twice their diameter; pre-apical part of head with fewer spots, very glossy. Rest of head with coarser, almost honeycomb-like speckling. Speckling on scutum and scutellum coarse, intervals between spots less than their diameter but some unspeckled areas occur. Spotting on mesothorax very dense and equally distributed, almost a honeycomb pattern, with intervals between spots not exceeding 1/4 - 1/2 their diameter. Speckling on walls of intermediate segments more delicate, but in places, especially on the tergite of the sixth segment, it is almost honeycomb-like; terminal portions of remaining segments with delicate but also dense speckling.

Head black. Distal portions of mandible and tarsi dark red. Ventral surface of antennal flagellum, fifth segment of tarsus, squammae and veins of the transparent wings (except for the darker subcostal and in part the pterostigma) are all light reddish-yellow. Spurs light yellow.

Body hairs white, scanty and short; those of scutellum and possibly those of frons, vertex and underside of head are longer. On the sides of the face, the scutum, and laterally on trunk there are found rather more decumbent hairs; moreover there is a development of terminal bands of white, decumbent scale-like hairs. Abdominal setae white; long and rather scanty hairs also occur on the abdomen. Hairs on the inner surfaces of all limbs are silver-grey.

Male: Length 5.0 mm. Similar to female. Head rather longer rounded, less flattened. Frons less than half the width of the eyes. Eyes twice as long as their greatest width. Mandibles rather short and wide, bidentate; keels clearly defined, less distinct at the base where they are widely separate. Middle portion of clypeus almost straight, faintly crenulate. Antennae (Fig. 2) long, extending as far as the intermediate segments; scape rather stout, four

times as long as its greatest width: 2nd segment of flagellum, 1 ½ times as long as its greatest width at the apex, segments 3-11 almost twice and segment 12 almost 2½ times as long as broad. Tergites 2-6 noticeably depressed at their bases (although these depressions are usually covered over); the sixth tergite is also depressed laterally. Tergite 7 (Fig. 3) not visible externally, rounded, with a broad notch in the middle of its posterior margin. Sternite 1 is broadly rounded, convex, and covered over to a large extent by the second sternite. Sternite 2 is concave laterally and widely cleft posteriorly. Sternite 3 is almost straight back and front but angular at the sides; it bears a wide lappet of dense hairs. Sternite 4 is slightly rounded back and front and very slightly notched. Sternite 5 (Fig. 4) bearing large basal lobes with almost straight sides; the apical, more highly sclerotinized portion is somewhat angular at the sides and notched; it bears a fringe of rather long, marginal hairs which are feathery at the sides; the elongate, feebly sclerotinized middle portion between the left and right terminal lobes is narrow; the external apical lobes are strongly elongated in a posterior direction in the form of obliquely sliced, digitate projections; on the inner side the sternite bears two long, slender, curved outgrowths which extend half way along the basal lobes; these outgrowths evidently serve for the attachment of accessory musculature. Sternite 6 (Fig. 5) with shorter, widely separated, basal lobes, which are straight along their outer edges; the posterior edge bears wide lobes rounded at the angles; the posterior half of the segment is covered laterally and medially with short, dense hairs and there is in addition, a fringe of hairs at the base of the outer edges of lobes. Sternite 7 is markedly reduced, very short and only faintly sclerotinized in the middle. Sternite 8 (Fig. 6) small with a narrow basal lobe, almost as broad as it is long, with straight sides and a broadly curved distal margin; the sternite bears in the middle a few very short hairs. Gonobases of the copulatory organs (Fig. 7) very short; Gonocoxites narrow and elongate, broad at the base, thickened, almost straight, with broad, rounded apices which are strongly curved medianly; ventrally the gonocoxites have patches, densely covered with short hairs. Volcelli short and wide,




Figs. 1–8. Heriades longicornis Popov, sp. n. male and female. 1) Head, female from front; 2) antenna, male; 3) 7th tergite, male; 4) 5th sternite, male; 5) 6th sternite, male; 6) 8th sternite, male; 7) copulatory organ, male; 8) segments of posterior tarsus, male.

fused at the base with the gonocoxites. Sagittae narrow, long, slightly curved and fused together dorsally to give a slightly sclerotinized membrane; basal lobes almost straight, short. First segment of posterior tarsus (Fig. 8) markedly curved, four times as long as wide; segments 2-4 are 1½ times as long as wide.

Clypeus stout, evenly speckled with rather large dots, anterior margin slightly wavy, glossy without dots. The speckling on the tergites is coarse and dense, the intervals between the dots not exceeding 1½ times their diameter; this sometimes results in a honeycomb-like sculpturing. Speckling of first tergite markedly more delicate; speckling of terminal portions of tergites 2-5 is more delicate also; speckling on the subterminal depression of the sixth tergite is scanty and its surface is glossy. Speckling of first tergite coarse, dots are large and dense; that of remaining sternite is considerably finer and less dense.

Color black. Mandibles, antennae, limbs (excluding trochanters) squammae and veins of transparent wings are yellowish-red, subcosta and pterostigma darker, spurs pale yellowish-white.

The fuzz on the head and dorsal surface of trunk is light ocher; beneath the head, on the ventral surface of the trunk, on the abdomen and the limbs it is grey. Hairs of clypeus, submentum and lateral parts of face are narrowly squamate, very dense, long, decumbent, completely obscuring the sculpturing of the integument. Beneath the head the hairs gradually lengthen toward the base. Trunk with rather scanty, long, semi-erect hairs; sides of pronotum and adjacent portions of mesonotum with coarse, squamate hairs which form a continuous narrow band; scutellum with dense, long, erect hairs. Tergites with a few, scanty, short, erect hairs, longer on tergite 6; tergite 1 with a broad terminal band and tergites 2-4 with narrow terminal bands of short, decumbent white scales.

Limbs with rather few, short hairs, longer on the posterior margin of the first tarsal joint and on the anterior margin of the last joint.

Kazakhstan: Tartugai, 1 female, 2 males, type (A. Shestakov).

The male is sharply distinguished from species of the subgenus Eutrypetes by the long antennae, the red limbs, the shape of the gonocoxites, the wide undifferentiated volcelli and the dorsally fused sagittae, together with the accessory processes of the fifth sternite. All these characteristics leave us with no doubts as to subgeneric affinities of the described species. Of particular interest is the coalescence of the sagittae. The beginnings of sagittal fusion are to be found in many groups - Hoplitis (Osmiini), but complete fusion only occurs in the genus Mesanthidium (Anthidiini); in both cases, the characteristic is of generic significance.

Females have the general structure characteristic of the subgenus Eutrypetes except for the development on the scutum of an anterior vertical surface, which is an extension of the pronotal vertical surface - a characteristic found in both sexes but not noted in the description of the subgenus.

In possessing long antennae in the male and in the structure of its sternites, the described species is similar to Heriades clavicornis armeniacus Popov, the precise systematic position of which is still undetermined; the latter species is, however, clearly distinguishable by its large size, unfused sagittae, blunt volcelli, the form of apical processes on the first sternite and by many other features.

It is worth mentioning that in the description of the Armenian subspecies of H. clavicornis, there is no mention of F. Moravits finding it in Erevan or of the alternative form of the distal antennal segment (Morawitz, 1876) a feature also ommitted by Schletterer (1889) in his redescription of the subgenus, when he used the male from Erevan as the type form of the subgenus.

Heriades (Eutrypetes) latipes Popov, sp. n.

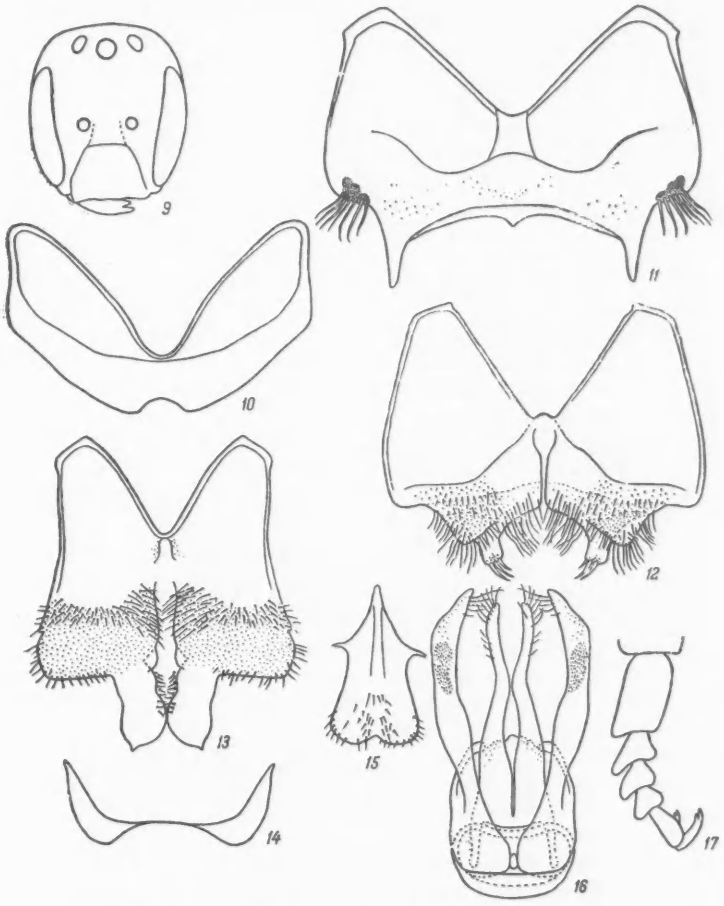
Female: Length 4 mm. Head (Fig. 9) large, somewhat wider than the trunk, barely longer than its width, rounded. Width of frons, approximately 1/3 that of eyes. Length of eyes, approximately 2½ times their greatest width; eyes broadly curved toward the base of the mandibles. Ocelli arranged in the form of a broad triangle; distance between median and lateral ocelli less than their diameter; distance between lateral ocellus and edge of vertex almost twice the diameter of the ocelli. Mandibles short, broad, tridentate, apical tooth long, median tooth adjacent to apical, third tooth short; keels well developed over their whole lengths, but rather less distinct at the base where they are widely separated. Maxillary palps 4-jointed, short 2nd and 3rd segments of almost equal size, 4th short and broad. Clypeus convex, almost half as long as broad, with a wide, shallow cleft, crenulate anterior edge. Submentum broad, flat. Antennae short, barely reaching the scutum; scape short, almost 4 times as long as its maximum width at the base, segments 2-5 shorter than their width; the successive segments almost as broad as long; the 11th segment longer than it is broad thickened at the apex. Lateral portions of pronotum narrow, with lamellate anterior margins. Scutum high, with a vertical anterior surface, which is an extension of the posterior edge of the pronotum. Parapsids barely noticeable, long, almost half as long as the squamae; the middle line is also poorly developed. Scutellum without lateral teeth, horizontal, elongate, almost half as long as the scutum. Postnotum short, twice as long as the horizontal part of the intermediate segment. Horizontal part of intermediate segment clearly differentiated, longitudinally ribbed with honeycomb ribbing. Median field of intermediate segment not differentiated. Abdominal tergites not compressed; transverse ridge at the boundary between vertical and horizontal portions of first tergite well defined along the whole breadth of the

tergite. Sixth tergite elongate and compressed at its extremity. First segment of posterior tarsus almost four times as long as broad.

Body glossy, with rather coarse, large speckles. Speckling of clypeus and submentum more delicate and irregular; median parts almost devoid of speckles, very glossy but laterally these structures possess rather larger spots which often have diameters greater than the intervals between the spots. Spotting of frons and vertex larger; on the frons the intervals between the spots are often as large as the diameters of the latter; the spots on the vertex are arranged in irregular rows, with the intervals between them considerably less than their diameters. Spotting on the scutum coarse, unequal and irregular; intervals between spots or groups of spots considerably greater than their diameters. Spotting on scutellum and lateral parts of scutum more regular and denser, the intervals between spots usually less than their diameters. Spotting at the sides of the intermediate segments denser but spots smaller in size; central field very glossy and devoid of spots. Spotting of tergites unequal and irregular and more delicate than on the head; intervals between spots usually less than their diameters; spotting of sixth tergite coarser and denser, especially at its end, where it forms a coarse honeycomb-like structure.

Body black. Distal half of mandibles and tarsi reddish. Flagellum of antenna light yellow. Squamae and veins of transparent wings yellowish-red, pterostigma and sub-costa darker. Spurs light yellow.

Body hairs white, scanty and short, but longer on the anterior margin of the clypeus, vertex, below the head, and particularly on the scutellum. Hairs on lateral parts of face, temples, along the front of the prenotum and at the sides of the thorax are decumbent, dense and narrow-




Figs. 9–17. Heriades (Eutrypetes) latipes Popov, sp. n., male and female. 9) Head of female, anterior view; 10) tergite 7, male; 11) tergite 4, male; 12) sternite 5, male; 13) sternite 6, male; 14) sternite 7, male; 15) sternite 8, male; 16) copulatory organ male, dorsal view; 17) segments of posterior tarsus, male.

ly squamate. Tergites 1-5 with narrow, terminal bands of squamate hairs, abdominal setae longer, rather sparse and silvery white; hairs on inner surfaces of all 3 pairs of limbs silvery white.

Male: Length 4-5 mm. Similar to female. Head almost as broad as long, flatter. Frons half as wide as distance between eyes. Length of eyes twice their greatest width; eyes oval. Mandibles short, rather broad, bidentate. Mandibular keels well developed, though less distinct at their bases where they are widely separated. Clypeus with almost straight, anterior margin which is almost devoid of hairs. Antennae rather long, almost reaching scutellum; scapes stout, 2½ times as long as their maximum width; second antennal segment half as long as broad, third segment not quite as long as broad, segments 4-7 of equal length and breadth, subsequent segments longer than they are broad, 11th segment almost twice as long as broad. Tergites 2-6 strongly depressed basally (although depressions are usually hidden). Tergite 7 (Fig. 10) is not visible externally, it is rounded, small, and bears an almost semi-circular notch in the middle of its posterior margin.

First sternite broadly rounded and covered by sternite 2. Sternite 2 elongately angled at the sides and wide ly indented in the middle of its anterior edge. Sternite 3 rounded at the sides, with an almost straight posterior edge and bearing a median, rather large, triangular process. Sternite 4 (Fig. 11) with large, basal, lateral lobes, from which arise tufts of hairs from their more strongly sclerotinized regions and with stout, pointed, lateral, tooth-like projections bounding the posterior margin of the sternite; the posterior margin is broad and bears a shallow depression, from the middle of which arises a short outgrowth. Sternite 5 (Fig. 12) with similar large basal lobes (although not as large as those of previous sternite); these lobes are sclerotinized, angular and covered with hairs, and are separated by a narrow strip of less heavily sclerotinized material; the 2 terminal lobes are drawn out into short, backwardly directed processes, each bearing 3 short setae; the posterior margin between these processes forms a rather broad, almost semi-circular median incision. Sternite 6 (Fig. 13) more elongate, with narrower basal lobes faintly notched laterally, sclerotinized, covered with hairs; terminal lobes broad, half the width of whole sternite, rounded at the sides with a straight posterior edge; posterior margin of lobes drawn out into 2 long, figured accessory lobes, each with an angular toothlet, delicately striated and bearing short hairs on their inner edges; a narrow, feebly sclerotinized strip separates the right and left halves of the sternite. Sternite 7 (Fig. 14) markedly reduced to give 2 small lateral lobes, joined by a very narrow anastomosis, which grows out of the ventral layer of the sternite 6, in the middle of which it lies in the normal position. Sternite 8 (Fig. 15) small with a triangular basal lobe, faintly indented laterally and broadly rounded distally, with a median notch; the distal half of the sternite is covered with scanty, short hairs. Gonobase of copulatory organ (Fig. 16) short, small and broader dorsally than ventrally. Gonocoxites narrow, elongate, broader at the base, angled in the middle of their outer edges, with rather long, concave inner edges and pointed apices (gonostyles not differentiated), bearing a few hairs on the outer edge; in front of the base of the undifferentiated gonostyles on the ventral surface of the gonocoxite, there is a small area, densely covered with short hairs. Volcelli long, narrow, expanded basally and fused with the gonocoxites, sagittae narrow, bent into S-shaped curves, slightly hairy distally; basal lobes short, almost straight. Length of first tarsal joints of hind limbs (Fig. 17) almost 2½ times their breadth, joints 2-4 very broad, strongly elongate posteriorly and markedly broader than long apically.

Clypeus with dense equal spotting, dull except for anterior margin which is glossy and devoid of spotting. Spotting of tergites coarse and dense, that of tergites 3-5 with the intervals between spots usually less than their diameters, and on the distal portions the spotting is sufficiently dense to form a honeycomb-like pattern; spotting on glossy tergite 6 fine and delicate, terminal lateral depressions almost unspotted, very glossy.

Coloration as in female, except that antennary flagella are darker.

Fuzz white, on clypeus, submentum and lateral parts of face very thick, decumbent and long, completely obscuring the sculpturing. On underside of head there are dense, erect hairs, gradually increasing in length toward base of head. Trunk with rather stout, semi-erect hairs; fuzz on pronotum rather short, erect, scanty, whereas that on scutellum is longer. Tergites with a scanty covering of erect hairs, which are considerably longer on tergites 4-6; tergites 1-4 with narrow, terminal bands of short decumbent scales. Limbs with a few short hairs, except for the posterior margins of the anterior tarsi where the hairs are longer and more abundant.

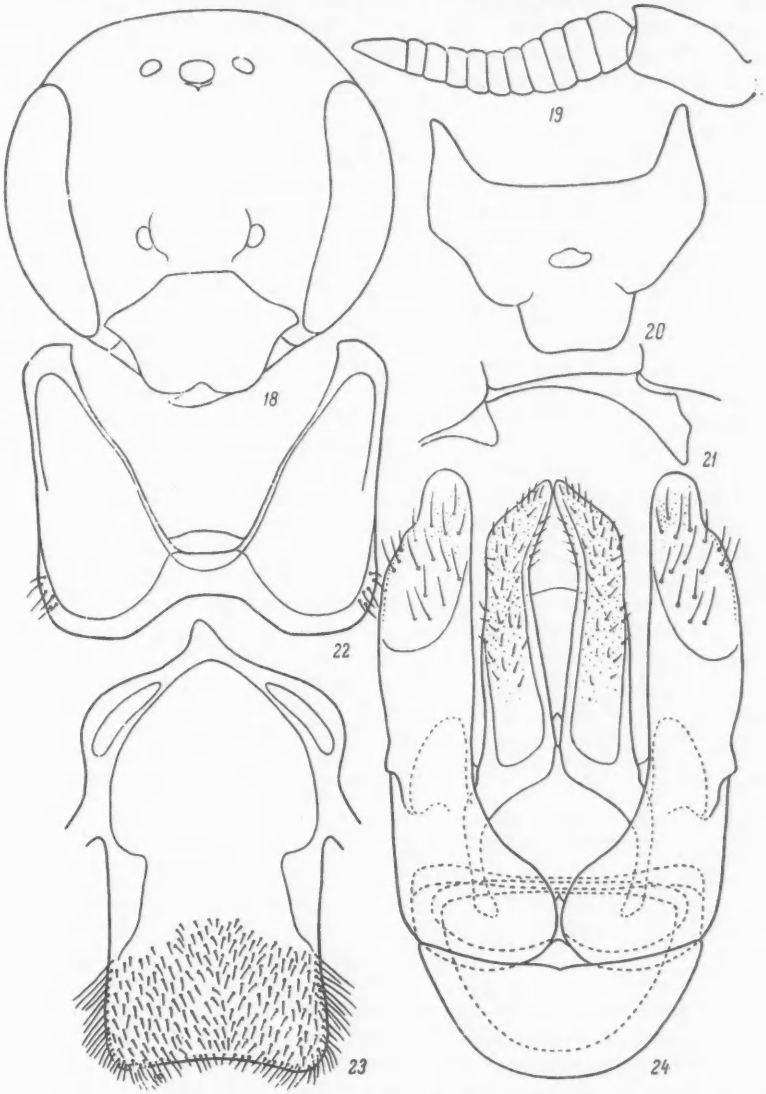
Kazakhstan: Tartugai, 2 females, 22 males (A. Shestakov); Baigakum near Dzhuleka, 7 June 1907, 1 male (L. Vol'man).

This species is readily distinguishable from all other species of the subgenus Eutrypetes by the wide segments of the posterior tarsi. The structure of its sternites and copulatory organ suggest that it is closely related to H. (E.) shestakovi Popov, from which it is readily distinguishable by several structural details, e.g., those of the 4th, 5th, 6th and 8th sternites and certain features of the copulatory organ.

## Hoplitis (Acanthosmia) acanthophora (F. Mor.)

Osmia acanthophora F. Morawitz, Izv. Obshch. lyubit. estestvoznan, antropolog. i etnograph, XIX, 2, 1875 : 101 male; Ducke, Ber. naturwiss - mediz. Vereins in Innsbruck XXV, 1900 : 120 male; Friese, Das Tierreich, 28, 1911 : 84 male.

Female. Length 8.5–9.5 mm. Head (Fig. 18) large, flat, equal in width to the thorax and almost as broad as long. Eyes noticeably close to the base of the mandibles and twice as long as their maximum width. Ocelli arranged in the form of a wide triangle, distance between median and lateral ocelli almost equal to their diameter; distance between lateral ocellus and edge of vertex equal to the distance between the lateral ocelli. Mandibles rather short and broad, tridentate; teeth large and almost equal in size; keels only well developed in the apical half. Genae poorly developed. Clypeus almost flat, and approximately as broad as long, tapering toward the apex, slightly notched in the middle of the anterior edge, which is almost completely hidden by the folded mandibles. Submentum broad, distinctly concave. Antennae short, not reaching as far back as the squamae, scapes rather narrow, four times as long as their maximum width; rest of antenna compressed, widening considerably toward the apex, first antennal segment rounded, barely as long as broad; segment 2 as long as broad;




Figs. 18–24. Hoplitis (Acanthosmia) acanthophora (F. Mor.) male and female. 18) Head of female, anterior view; 19) antenna, male; 20) tergite 7, male; 21) processes of sternites 1 and 2, male, lateral view; 22) sternite 7, male; 23) sternite 8, male; 24) copulatory organ, male, dorsal view.

segments 3-10 approximately 4 times as long as broad; segment 11 more than 1½ times as long as broad, tapering at its apex. Humoral prominences rounded, often with barely noticeable ridges. Scutum markedly convex. Parapsids well developed, short, less than 1/4 the length of the squamae, median line barely discernible. Median field of intermediate segment clearly delimited. Terminal portions of tergites slightly compressed. Tergite 6 elongate and strongly compressed at its tapering end. First segment of anterior tarsus broad, approximately 2½ times as long as it is wide; first segment of middle tarsus twice as long as broad and first segment of posterior tarsus 4 times as long as its maximum width.

Body faintly glossy and coarsely and densely speckled. Spotting on clypeus honeycomb-like subapically, almost honeycomb-like at the sides, with a broad wedge of unspotted cuticle stretching from the base almost to the apex. Middle portion of frons devoid of spots, together with a narrow strip of integument from the median ocellus to the clypeus. Rest of head densely spotted, the intervals between the spots considerably less than their diameters; sometimes groups of spots form a honeycomb-like pattern. Spotting of scutum and sides of thorax rather coarser than that of head; intervals between spots, usually not exceeding 1/4—1/2 their diameter; sometimes the spots fuse together; spotting of scutellum and sides of scutum very dense, giving a cellular pattern. Sides of intermediate segment with a shagreen-like pattern; median field of intermediate segment similar at its base but glossy and unspotted elsewhere. Spotting of tergites more delicate than that of scutum, irregular intervals between spots varying from half to the same as the diameter of the spots; spotting of terminal compressed portions of tergites coarser, almost honeycomb-like; spotting of sixth tergite very coarse.

Body black. Terminal tarsal joints, squamae, veins of wings all reddish. Spurs light-reddish-yellow. Hairs on head and thorax rather long, irregular and dense, those on abdominal tergites shorter and erect. Hairs of clypeus, face, temples, mesothorax and limbs, light yellow, almost grey, as are the abdominal setae; hairs on vertex, scutum and scutellum bright orange-yellow. Hairs on abdominal tergites light yellow, with terminal bands of white on tergites 2-5; the hairs forming these bands are rather long, dense, decumbent and uninterrupted. Inner surface of tarsus pale gold.

Male. Length 9.5—11.0 mm. Head hardly as broad as long, considerably stouter than in female, rounded, faintly indented on the vertex, with a slightly projecting clypens, covered by the base of the labrum. Mandibles rather broad, short with a bidentate, curved, apex; teeth broad and almost equal in size. Maxillary palp 5-jointed, rather short; length of 3rd segment almost twice that of the others. Eyes narrow, almost 4 times as long as their maximum width. Ocelli form a broad triangle. Distance between lateral ocellus and apex of eye is noticeably greater than distance between the two lateral ocelli. Genae very narrow and flange-like. Labrum barely as long as its width at the base, broadly rounded distally. Clypeus half as long as broad, with a notch in the middle of its rounded anterior edge and slightly projecting lateral angles. Antennae (Fig. 19) short, reaching as far back as the squamae, scapes strongly thickened, twice as long as broad; rest of antennae compressed, basal segments very broad and equal in width to the scapes; first antennal segment completely hidden by the distal end of scape; second antennal segment twice as broad as long and markedly expanded at its apex; segments 3-9 twice as broad as long, gradually decreasing in size to the 9th; 11th segment twice as broad as long; 12th segment twice as long as its basal length and tapering sharply to a pointed apex; segments 1-4 possess wide rounded depressions on their ventral surfaces. Lateral portions of pronotum narrow, short. Parapsids short, 1/4 the length of the squamae. Notouls long, 1/3 the length of the squamae. Median field of intermediate segment short and wide, clearly delimited. Abdomen long, circular in transverse section, strongly recurved. Tergites 1-4 with rather feebly developed terminal depressions, of which the width does not exceed 1/4 the length of the tergite. Tergite 6 with strongly developed lateral toothlets in front of its extremity and with broadly rounded and slightly raised anterior edge. Tergite 7 (Fig. 20) with a deep, circular depression at its base and a small, almost square terminal lobe, with rounded corners and noticeably keeled at the base. Sternite 1 (Fig. 21) with a longitudinal keel, noticeably raised up and projecting forward in the center of its anterior edge. Sternite 2 with the center of the anterior edge drawn out into a long, angled and slightly keeled process, which extends as far back as the third tergite. Sternite 7 (Fig. 22) with very large basal lobes, with almost straight lateral margins and a broad posterior margin, which is broadly notched in the middle, so that the terminal portion of the sternite is very short, its length being only 1/4 that of the basal lobe; there are groups of short hairs on the sides of this sternite. Sternite 8 (Fig. 23) large, almost rectangular, with a slightly drawn out and more rounded base and a faintly indented posterior margin; the terminal portion bears short hairs and rather longer marginal cilia. The gonobase of the copulatory organ (Fig. 24) very elongate dorsally, short almost discontinuous ventrally. Gonocoxites long and rather wide, strongly compressed dorso-ventrally, with straight, widely rounded apices which are considerably narrower than the rest of the gonocoxite is concave and bears a few, rather long hairs. Volcelli well developed, rather large, flat and rounded. Sagittae wide, immovably fused at the base and fused also with the dorsal wall of the penis; free ends of sagittae pointed and curved toward the mid-line; dorsally the sagittae are covered with scanty, short hairs; basal processes slender, strongly curved toward the base. Posterior femora faintly swollen.

3 1/2 times as long as their maximum width, of same length as the tibiae. First segment of posterior tarsus narrow, 5 times as long as broad (2nd almost twice as long). Spurs long, 2/5 the length of the first tarsal segment.

Body faintly glossy, densely and coarsely spotted. Clypeus dull, rather lightly but very coarsely spotted, with the spots completely touching each other; down the middle there is a narrow, unspotted, glossy stripe; front edge of clypeus with a similar narrow strip of unspotted cuticle. The spotting of the rest of the head and thorax is coarse, with the spots very near together, the glossy intervals between the spots being 1/4 to 1/2 their diameter. Spotting of intermediate segment delicate, intervals between spots equalling their diameters. Spotting of abdominal tergites delicate and very similar to that of intermediate segment but more irregular, the intervals between spots either equal to or several times their diameters; often the spots almost touch each other but on tergite 6 they are particularly scanty; the tergite is glossy especially in the middle where the spotting is almost entirely absent. Spotting of compressed terminal portions of tergites 2-5 noticeably more delicate; on the compressed part of tergite 6 it is coarser; margins of the tergites with narrow unspotted bands, glossy; spotting of sternites coarse and in places rather scanty.

Body black. Distal segments of tarsi, squamae and veins of wings dark colored; wings reddish brown; spurs light yellow.

Body with a few, long, greyish-ocher hairs, and grey hairs on the underside; at the side of the head capsule near the mouthparts and on the anterior coxae, the hairs are dense, short and erect; they are sparser and decumbent on the thorax and long and erect on the abdomen, tibiae, and edges of tergites. Sternites 4 and 5 with marginal bands of dense, decumbent golden hairs. Inner surfaces of tarsal segments with light golden hairs.

The species was known as a male from the Zeravshanskii valley, caught by the road through the Sangy-Dzhuman Pass. The new material is from Rudasht, 3000 m. in the Gissarskii Mts., 22 July 1957, 1 male (V. Gussakovskii); Ziddy, on the southern slopes of the Gissarskii Mts., 19 July 1944, 1 female and 21 Aug. 1944, 1 female (type specimen), 1 male (M. Nikol'skaya). R. Gursy-Tash, valley of R. Kara-Shyr in the Petra I Mts., 26 July 1911, 1 male (A. Gol'bek).

This species is closely related to the Caucasian species H. antennata F. Mor. (discovered at Shafnabedella near Lake Tabitskhur), a fact which had previously been noted by F. F. Morawitz (1875) in describing the latter species; Moravits erroneously compared his specimens from Zeravshanskii, in the first place, with H. tuberculata (Nyl.).

The newly described female is closely related to H. mitis Nyl. (montivaga F. Mor.), but may be distinguished from the latter by its larger size, coarser spotting on the clypeus and scutum, and almost honeycomb-like spotting of the vertex, together with other differences.

Hoplitis (Acanthosmia) laminifera Popov, sp. n.

Female. Length 12 mm. Head (Fig. 25) large, barely narrower than the trunk, its length almost equal to its breadth. Frons equal in width to the eyes. Eyes noticeably converging toward the mandibular bases, twice as long as their greatest width. Ocelli arranged in a wide triangle; distance between lateral ocellus and edge of vertex greater than the distance between the two lateral ocelli. Mandibles rather short and wide, with 3 teeth, which are large and almost equal in size; keels well developed only in the apical half. Genae not developed. Maxillary palps 4-jointed, short; first segment very much expanded, second twice as long as broad, third and fourth very short, half the length of the second. Proboscis short, slightly longer than the scape of the antenna. Clypeus almost flat, noticeably broader than longer, partially hidden by mandibles. Submentum broad, slightly convex. Edge of occiput clearly defined over its whole length; occiput strongly costate, with 3 large, deep depressions at its base—one in the middle and 2 on each side of the line marking the inner edge of the eyes. Hypostomial prominence well-defined, bearing laminate toothlets at its angles; toothlets equal in length to two antennal joints. Antennae short, barely reaching the squamae; scape slender, six times as long as broad; antennal filament somewhat compressed, slightly expanded at the apex; segment 1 rounded; segment 2 slightly longer than its apical width; segments 3 and 4 a little wider than long; 5—10 of equal width broadly rounded at their apices. Humoral prominences rounded with feebly developed ridges. Parapsids well developed, 1/4 the length of the squamae; median line and notauls barely noticeable. Scutellum slightly convex, considerably more than 1/4 the length of scutum. Median field of intermediate segment clearly delimited. Terminal portions of tergites narrow and strongly hollowed out. Tergite 6 elongate and sharply compressed distally. First segment of anterior tarsus slightly compressed, four times as long as broad and with a rounded keel at its base; first segment of middle tarsus strongly compressed, tapering toward its distal end and more than five times as long as its greatest width.

Body glossy, with coarse and frequently dense spotting. Spotting of clypeus honeycomb-like, but more delicate subapically; anterior margin of clypeus unspotted and glossy. Spotting of rest of head somewhat coarser, often honeycomb-like, except on parts of frons and vertex where there are glossy intervals between spotting; edge of occiput unspotted, glossy. Spotting of scutum and sides and abdomen coarser, honeycomb-like; only in the middle of the scutum and a few other places is it less dense, with the intervals between the spots attaining 1/2

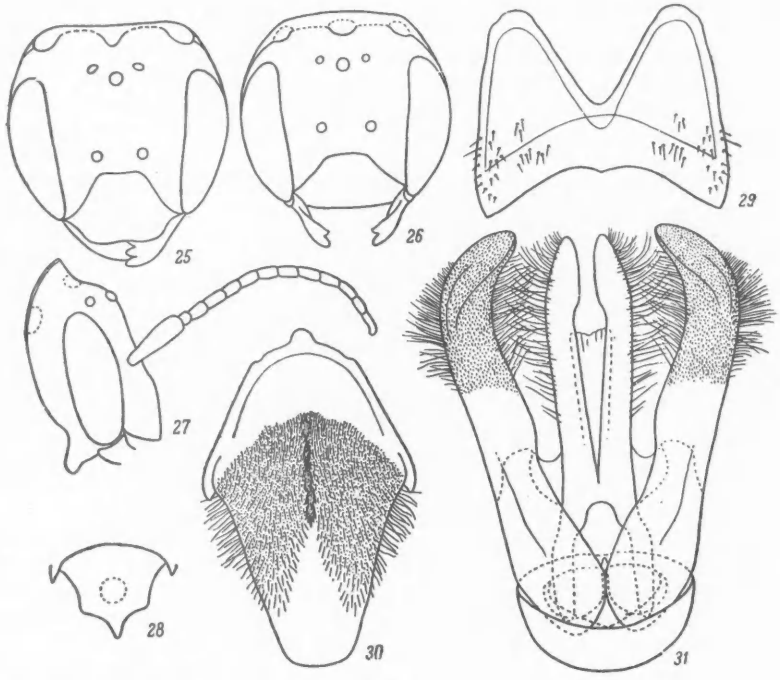
the diameter of the spots. Sides of intermediate segment with rather more delicate, cellular spotting; median field dull with basal half covered in honeycomb-like spotting and the apical half like shagreen leather. Spotting of glossy tergites 1–5, rather scanty and regular, intervals between groups of spots attain 1/2 their diameter; inner groups of spots sometimes very close together. Tergite 6 dull, with more delicate honeycomb-like spotting.

Body black. Tips of mandibles, antennal filaments and trochanters darkened Squammae and veins of yellowish wings are yellow-brown. Spurs yellowish.

Hairs on head and trunk rather short and dense, but longer on frons; on the periphery of scutum, scutellum and on sides of intermediate segment, yellowish-grey, or ocher on scutum. Hairs on tergites scanty and short, yellowish-grey; terminal stripes of tergites 1–5 wide, greyish, hairs decumbent. Abdominal setae rather long, light colored. Fuzz on tergites 6 and on limbs very short, decumbent. Hairs on inner surfaces of tarsi light golden yellow.

Male. Length 14 mm. Similar to female. Head (Figs. 26 and 27) small, narrower than trunk, relatively tapering toward vertex, noticeably longer than broad. Frons narrower than width of eyes. Eyes barely converging toward base of mandibles, twice as long as their maximum width. Mandibles rather short and narrow, angular, with 2 teeth. Maxillary palps longer and slenderer than in female, 4-jointed. Clypeus flat, noticeably broader than long, with a rounded and very slightly notched anterior edge; its base covered by mandibles. Edge of occiput more clearly expressed than in female; the 3 depressions at its base are wider and deeper than in female. Hypostomial prominence very strongly developed in the form of a triangular plate, blunt at its tip and about as long as the antennal filament. Antennae long, almost reaching the scutellum; scapes rather stout, more than four times as long as their greatest width; antennal filament faintly compressed, not expanded at its apex; segment 1 noticeably broader than long; 2–11 almost equal in size and 1½ times longer than broad; segment 12 slightly longer, rounded at its distal end and slightly bent externally and ventrally.

The terminal portions of tergites 1–6 show very little compression. Tergite 6 has a slightly rounded terminal margin, with small toothlets at the side. Tergite 7 (Fig. 28) strongly drawn out, rounded at the sides, with a well-developed triangular tooth in the middle of its terminal edge and in front of which a deep depression is found. Sternite 1 with a large, perpendicular, rounded, plate-like projection. Sternite 2 with a small, median, flatten-




Figs. 25–31. Hoplitis (Acanthosmia) laminifera Popov, sp. n. male, female. 25) Head of female, anterior view; 26) head of male, anterior view; 27) head of male, lateral view; 28) tergite 7, male; 29) sternite 7, male; 30) sternite 8, male; 31) copulatory organ, male, dorsal view.

ed spine, similar to that of H. mitis Nyl. (= montivaga F. Mor). Sternite 3 with a small, angular outgrowth in the middle of its posterior margin. Sternite 4 with an almost straight terminal margin and a barely noticeable median projection. Sternite 5 has a longer median projection and notched terminal margin. Sternite 6 is longer with a straight margin and no median projection. Sternite 7 (Fig. 29) has very large basal lobes, almost straight lateral edges and a broad terminal margin, widely indented; the terminal portion of the tergite is very short, being only half as long as the basal lobes; lateral subterminal portions bear a few short hairs. Sternite 8 (Fig. 30) large, with shorter, slightly angular, basal part and longer tongue-like terminal portion, noticeably tapering toward a straight tip; middle section of sternite densely spotted and thickly covered with short hairs; there is a median band of stout setae. Gonobase of copulatory organ (Fig. 31) rather short dorsally, approximately only half of its ventral length. Gonocoxites long and rather broad, dorso-ventrally flattened, with rounded and even more flattened apices, strongly curved toward the midline; distal half much darker in color and almost completely covered with rather long, dense hairs. Volcelli present, single-jointed, flat, rather large. Sagittae rather narrow, dorso-ventrally flattened, almost straight and fused at the base; free ends of sagittae slightly pointed; dorsally the external surfaces of the sagittae bear long hairs; basal processes rather slender, and slightly curved toward the base. Coxae of posterior limbs with well-developed ventral toothlets. Femora and tibiae of posterior limbs markedly thickened, tibia curved ventrally, so that it appears to have a large bite out of its structure.

Body faintly glossy, with coarse and dense spotting. Spotting of clypeus dense but more delicate, resembling shagreen leather, barely glossy. Spotting on rest of head coarse, honeycomb-like, with only a few glossy patches; for the most part intervals between spots are equal to or greater than their diameters. Margin of occiput unspotted, glossy. Spotting on scutum and sides of abdomen coarse, almost honeycomb-like laterally and even coarser and more irregular on scutum; in the middle of the scutum the intervals between the rows or groups of spots are equal to or greater than their diameters. Spotting on glossy tergites 1–6 is regular, rather coarse and dense, with the intervals between spots equal to or greater than their diameters; edges of tergites with a narrow strip of more delicate, honeycomb-like spotting. Spotting on tergite 7 delicate, honeycomb-like at the base, sparser and more coarse over the terminal portion. Spotting on sternites partly coarse and less regular.

Body black. Tarsal segments and veins of yellow wings reddish-brown. Antennal filaments and squamae pale yellowish-red. Spurs light-yellow.

Body hairs very dense, long, yellowish-grey; hairs on vertex and scutum ocher-colored; denser on clypeus and face, below the head and on the abdominal tergites. Terminal bands on tergites 1–6 with semi-erect hairs. Sternites with bands of semi-erect hairs on their terminal parts. Hairy covering to limbs long and dense.

Tadzhikistan: Kondar 1110 m. Gissarskii Mts., 26 June 1939, 1 male and 4 July 1937, 1 female (V. Gussakovskii).

This newly described species is clearly distinguished from all other species of Hoplitis by the strongly developed occipital comb, the depressions at the base of the vertex and the strong development of the hypostomial prominence. The latter characteristic and the presence of ventral teeth on the posterior coxae suggest affinities with the North American sub-genus Dasyosmia; in the development of a median stripe of stout setae on sternite 8, the species is near to the subgenus Megalosmia (distributional range, Hungary to Mongolia).

## Osmia difficilis F. Mor.

Osmia difficilis F. Morawitz, Izv. Obshch. lyubit. estestvoznan, antropolog i étnograf, XIX, 2, 1875 : 91 females; Ducke, Ber. naturwiss-mediz. Verein in Innsbruck, XXV, 1900 : 129 females. Friese, Das Tierreich, 28, 1911 : 87 females; Popov Ushchel'e Kondara, 1951 : 169 females; Alimdzhanov and Bronshtein, Fauna bespozvonochnyk Zeravshanskoi doliny, 1956 : 290 (syn. nov.).

The female was described by F. Morawitz (1876) from examples taken by A. P. Fedchenko at Urgut on May 23, the male was obtained from the road through the Sangi-Dzhuman Pass, May 25. Because of the unusual characteristics of the male, the two sexes were described as different species. Later males and females were found by V. V. Gussakovskii near the Kvak landmark in the Gissarskii Mts.; at first these were erroneously referred to the genus Hoplitis (Popov, 1951), the type species of which is H. adunca (Pz.).

Later examinations of the type females (Zoological Museum, M.G.U.) and males (Zoological Institute AN SSSR), together with supplementary material, enabled the two sexes to be referred to a single species.

This conclusion was reached on the basis of the size of the 2 sexes, their coloration, spotting, characteristics and coloration of hairy covering, together with data on the distribution habitats and phenology.

Both sexes are sufficiently well described by Morawitz. The author's present description is only a supplementary one.

Maxillary palps with 4 free segments, rather long, almost equal in size, with only the distal segment very short and slender. Labial palps 4-jointed, the third triangular, barely wider at the apex than the second; the fourth slender, twice as long as the third, slightly curved toward the base with a tapering apex.

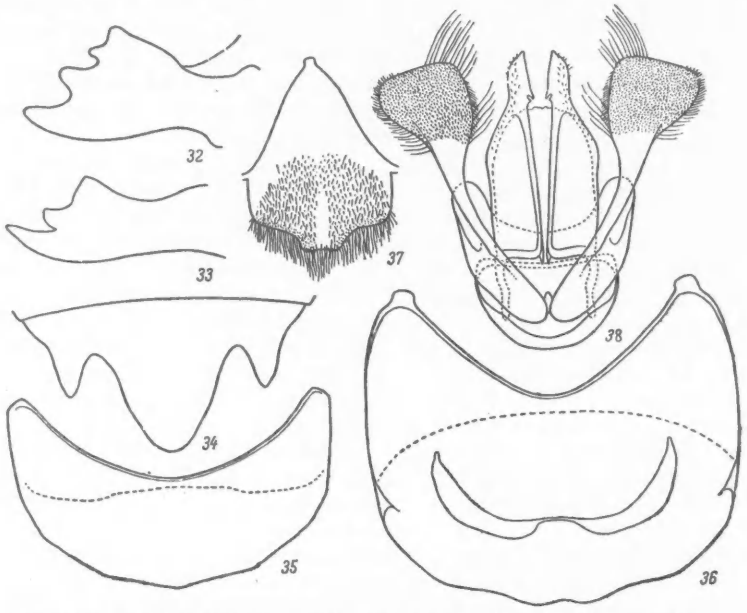
Female. Length 9.0–13 mm. Mandible with 4 teeth (Fig. 32), the 2 inner teeth small, wide and only feebly delimited from each other, the third considerably larger,

the fourth (external tooth) large and elongate, sometimes strongly eroded; in the middle of the ventral (external) margin there is situated a well developed tooth, directed inwards; the mandible is broad but rather constricted in its proximal half.

Distance between lateral ocellus and apex of eye equal to distance between lateral ocellus and edge of vertex and considerably greater than the distance between the two lateral occelli. Eyes 3½ times as long as broad. Frons approximately 1½ times the width of the eyes. First segment of antennal filament 1½ times as long as broad; second segment twice as long; segments 3–6 noticeably broader than long; segments 7–10 noticeably longer than broad and the 11th segment 1½ times as long as broad.

Head and trunk with large, coarse, honeycomb-like spotting, slightly less dense on the frons, the middle of the scutum and the sides of the mesothorax; in these places the intervals between the large spots are themselves dotted with very fine spots. Spotting of tergites more delicate, irregular; edges of tergites with a narrow, unspotted border, adjacent to which is some very fine honeycomb-like or almost honeycomb-like spotting. Tergites 1–3 very sparsely spotted, intervals between spots almost equal to their diameters and between rows 1/2–2 times their diameter. Spotting on tergites 4–6 very dense, honeycomb-like.

Male. Length 11.5–13 mm. Mandibles with 2 teeth (Fig. 33); in place of the 2 internal teeth found in the female, there is a straight edge to the mandible; the two existing teeth are more pointed than those of the female and the mandible itself is narrower, less tapered in its basal half; the ventral (external) edge lacks a median tooth. Distance between lateral ocellus and apex of eye is almost equal to distance between lateral ocellus and edge of vertex. Eyes twice as long as broad. First antennal segment almost as broad as long; second segment twice as long as broad; segments 3–10 1½ times as long as broad and segment 11 twice as long as broad. Tergite 6 (Fig. 34) of triangular form. Tergite 7 (Fig. 35) not visible externally, with small basal lobes and a rounded terminal portion. Sternite 2 large, partly hidden by terminal portion of sternite 3, broadly rounded, with a small, median notch. Sternite 3 with a broad, deep notch on its terminal margin. Sternite 4 with a broadly rounded, terminal margin. Sternite 6 (Fig. 36) large, with a broadly rounded, terminal margin, which possesses a slightly wavy indentation. Sternite 7 (Fig. 36) markedly reduced, small and consisting of two elongate and very narrow parts joined by an exceedingly narrow bridge, 1/3 the width of the lateral portions; this sternite lies flat against sternite 6, 1/3 of the way along the length of the latter. Sternite 8 (Fig. 37) with a large, triangular, basal portion and a short terminal portion, which possesses a wide, straight edge, bearing a median, blunt-ended, tongue. Gonobase of copulatory organ (Fig. 38) strongly reduced, especially its ventral portion, which is represented by very narrow, straight processes. Gonocoxites long, narrow, very slender in the middle, where they are joined by a less heavily sclerotinized bridge to the volcelli,




Figs. 32-38. Osmia difficilis. F. Mor. male and female. 32) Left mandible, female; 33) left mandible, male; 34) 6th tergite, male; 35) 7th tergite, male; 36) 6th and 7th sternite, male, inner side; 37) 8th sternite, male; 38) copulatory organ, male, dorsal view.

and markedly compressed at the apices where they are covered by long hairs; the latter characteristic is somewhat similar to that which occurs in Parevaspis, Protostelis signata (Latr.) and Pseudoanthidium alpinum (F. Mor.) and is most unusual in the genus Osmia. Volcelli flat, elongate, rounded and not separated from the gonocoxites. Sagittae strongly expanded, straight, long, immovably joined together, with heavily sclerotinized and sharply pointed apices and with a small tooth-like projection at the base of their outer edges. Spotting similar to that of female, but the spotting on the sides of the mesothorax is more regular and honeycomb-like; spotting of tergites more delicate and their edges have a wider unspotted border than in female; furthermore, the spotting on tergite 6 is less regular and the intervals between the spots are somewhat greater than their diameters; intervals between rows considerably less than their diameters. Spotting on sternite 5, in part more delicate and denser than in the preceding case.

There is no doubt that O. difficilis F. Mor. belongs to a special subgenus of its own; the position of this subgenus among those already recognized is still not clear. F. Morawitz considered the female closely related to O. maracandica F. Mor., a species which is now assigned to the subgenus Helicosmia (Type species O. (H.) aurulenta Panz.); but O. difficilis also shares many features in common with the subgenus Melanosmia (Type species O. fuciformis Latr.). Both these subgenera have received inadequate study and attention but, so far as is known, the structure of the copulatory organ in O. difficilis is different from that typical of either subgenus.

Of particular interest is the structure of the gonocoxites in the male O. difficilis, for it is similar to that found in some parasitic forms (Parevaspis, Protostelis) and also in montane species (Pseudoanthidium).

New material: From stretches of the Dukan—Khana River, May 25, 1911. 1 male(A. Gol'bek); Varzob, June 29, 1932. 1 female (H. Fursov); Kondara Ravine, June 4. 1939, 1 female, (V. Gussakovskii); Ziddy, Aug. 5,1938, 1 female (V. Gussakovskii); Khodzha—Obi—Garm, July 31, 1944, 1 female (M. Nikol'skaya); Anzob Pass, July 31, 1937, 1 female (V. Gussakovskii); Anzob Pass, July 28, 1937, 3 females (V. Gussakovskii).

As may be seen from the above list the species is widely distributed in the Gissarskii Mts., where it occurs at altitudes from 850 m (Varzob) to 3379 m (Anzob Pass). The species is found also in the Zeravshanskii Range (Urgut).

It flies from the first half of June to the beginning of August, the males being on the wing earlier than the females.

The plants which it frequents are not known, despite the observation by Alimdzhanova and Bronshtein that this species is found on various plants. Analysis of pollen grains adhering to specimens has been carried out by Professor L. A. Kupriyanova (Institute of Botantical Sciences, Academy of Sciences, USSR), who has shown that the 7 females from Varzob, Kondara, Kvak, Anzob and Khodzha—Obi—Garm must have visited papilionaceous flowers (species undetermined); those from Kondara had evidently visited flowers of Astragalus.

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# NEW SPECIES OF SYRPHIDAE (DIPTERA) FROM THE CAUCASUS

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Collections made in Transcaucasia, mainly by V. A. Richter, during the past few years have added considerably to our knowledge of the Syrphid fauna of that region. The completeness of these collections, together with the presence in them of certain unexpected and interesting forms prompted the author to undertake a revision of the Syrphidae of Transcaucasia, the initial consequences of which are the descriptions of new species given below.

The types of all these new species are preserved in the Zoological Institute, Academy of Sciences, USSR collection at Leningrad, except for the female allotype of Eumerus richteri Stack., sp. n., which is to be found in the museum of the Moscow State University at Moscow and the female paratype of Penthesilea talyshensis Stack. sp. n. which is preserved in the Zoological Institute, Azerbaidzhan Academy of Sciences in Baku.

The figures in this particular article have been drawn by the artist P. V. Chernysheva.

## Pipizella curvitibia Stackelberg, sp. n.

This is the largest of the known palearctic species of its genus (body length 9 mm). It may be distinguished from other palearctic species of the genus by the following characteristics: the definite curvature and thickening of the distal half of the middle tibia in the male [Fig. 2]; the fact that the greater part of the anterior and middle tibiae is yellow with only a narrow black ring around the joint; the definite yellow bases to the wings and also the peculiar structure of the apical crosspiece m (= apical transverse vein—Fig. 3).

Male. Frontal triangle black, having a distinct metallic luster, with long yellow hairs confined to the region at the base of the antenna and a few long black hairs elsewhere; face black, with a bluish tinge and metallic luster, also long whitish hairs; vertex black, with metallic luster and elongate whitish hairs; occipital area rather wide with a faint whitish bloom and white hairs. Eyes with dense covering of long white hairs. Antennae black; length of third segment is 2½ times its width [Fig. 1]; arista short and almost equal in length with the third antennal segment, light brown in color. Thorax bronze with metallic luster, finely dotted; scutum and scutellum with very long, bright golden hairs; middle portion of thoracic wall (posterior mesopleuron, pteropleuron and sternopleuron) with very long, fluffy, golden-yellow hairs. Coxa and femur, except for their yellow apices, black; anterior and median tibiae bright yellow with a narrow black ring in the distal half; distal end of these same limb-segments yellow; median tibia is distinctly curved and thickened distally [Fig. 2]; posterior tibia except for its yellow base, is black; anterior tarsus definitely expanded distally, black, with first joint yellow; first and second joints of median tarsus yellow, third to fifth joints black; posterior tarsus black above, yellow below. Wings transparent, with yellow bases; apical sector m (= apical transverse vein) bent into a marked S-shaped curve at right angles to both m and $r_{4+5}$ [Fig. 3]. Thorax bronze with a metallic luster, covered dorsally with short, dense, erect, yellow hairs; ventrally with white hairs, some erect, some decumbent.

Female. Frons relatively wide, lustrous, having a single patch of grey bloom laterally. Antenna longer than in male [Fig. 4]; length of second antennal segment is approximately twice its width at the apex; length of third antennal segment approximately three times its width. Scutum and scutellum with relatively short, white erect hairs.

Middle tibia not thickened nor curved; black ring around anterior and middle tibiae incomplete; first and second joints of anterior tarsus and first three joints of middle tarsus yellow; apex of posterior tibia yellow. Wings bright-yellow at the base; apical cross vein m faintly curved. Thorax with very short erect hairs dorsally.

Length of body 9 mm.

Holotype male: Kyalakhan, Lerikskii District Talysh, May 27th, 1959 (1 male; V. Richter); allotype, female: Lyaketag, Dzhul'finskii District, Nakhichevansk ASSR, June 30th, 1959 (1 female; V. Richter).

## Cheilosia armeniaca Stackelberg, sp. n.

This species belongs to the Ch. caerulescens Mg.—Ch. helvetica Wainwr. group. Eyes naked; limbs partly yellow; arista naked; transverse veins of wing with a distinct brownish border. The species may be distinguished from Ch. caerulescens Mg. by the absence of any black setae along the posterior margin of the scutellum;

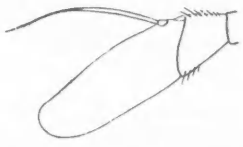

Fig. 1. Pipizella curvitibia Stack., sp. n. male. Antenna.

from Ch. helvetica Wainwr. it may be distinguished by the wide, short abdomen (as seen in dorsal view), the length of which does not exceed the length of the head and thorax together [Fig. 6], and also by the presence of long, fluffy, almost white hairs which cover the scutum and scutellum (in Ch. helvetica the hairs covering the scutum and scutellum are relatively short and golden yellow). Ch. armeniaca is also closely allied to Ch. kerteszi Szil. [Szilady, 1938 : 138], from which it differs in having a glossy black frons in the male, and in having long white (not reddish yellow) hairs on the scutum, also in the presence of two rows of setiform hairs on the lower surface of the distal half of the posterior femur.

Male. Head relatively wide; frons convex, black glossy, coarsely granular, with a median furrow and a dense covering of long, pure white hairs; face strongly elongate anteriorly, with a large median protuberance which projects further forward than the mouth [Fig. 5], glossy black, naked, except for a grey bloom below the antennae; this grey bloom extends along the edges of the eyes in the form of gradually narrowing stripes, which pass over on to the genal region of the face but are only well developed ventrally; the genae below the eyes are relatively high (approximately a fifth the height of the eyes themselves), glossy black, with erect white hairs situated on their posterior parts; vertex glossy black, with white hairs; occiput greyish-white, relatively broad with a dense covering of greyish-white hairs; eyes naked; the line of contact between the eyes equal in length to the height of the triangular vertex. Antennae short, black; 3rd antennal segment small, rounded, black in color with a greyish bloom; arista naked, slightly expanded at the base and gradually narrowing toward the apex. Thorax glossy black; scutum glossy and in parts coarsely spotted, with two large patches of grey bloom along the anterior edge; scutum and scutellum covered with long, erect, fluffy hairs which are whitish in color; hinder margin of scutellum bearing hairs but no setae. Limbs black; trochanters yellow; basal third of anterior and middle tibiae brown; anterior and posterior tarsi reddish-yellow below; first three segments of middle tarsus reddish-yellow both ventrally and dorsally; femora with long, erect, white hairs; anterior tibia with golden yellow hairs along its anterior face; tibiae of other limbs with short white hairs, wings transparent; veins black to the base of the wings; wing bases grey (not yellow!); apical sector m relatively short and meeting $r_{4+5}$ at right angles; the bases of veins $r_{2+3}$ and $r_{4+5}$ together with the transverse veins of the middle parts of the wing all have brownish borders; the stigma (apical portion of cell Sc) light brown in color, darker at the base. Abdomen short and wide, oval anteriorly, tapering posteriorly [Fig. 6], black with a metallic luster, but lacking any coarse granular spotting; with a dense covering of moderately long, erect white hairs on the upper surface and a few long white hairs ventrally; hypopygium glossy black with long white hairs.

Body length 8.5 mm.

Female not known.

Holotype: Eastern slopes of the Kapudzh Mts., Armenia, August 17th, 1959 (1 male, Zaitsev).

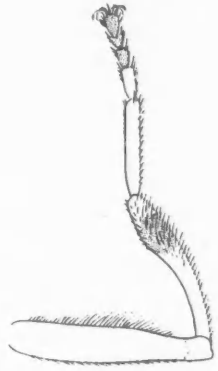

Fig. 2. Pipizella curvitibia Stack., sp. n. male. Middle limb.

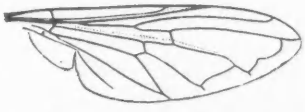

Fig. 3. Pipizella curvitibia Stack., sp. n. male. Wing.

Fig. 4. Pipizella curvitibia Stack., sp. n. female. Antenna.

Fig. 5. Cheilosia armeniaca Stack., sp. n. male. Head in profile.

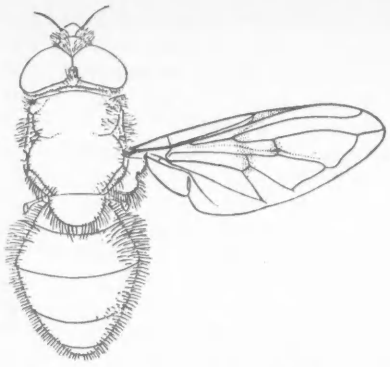

Fig. 6. Cheilosia armeniaca Stack., sp. n. male.

Cheilosia transcaucasia Stackelberg, sp. n.

Eyes covered with hairs. Face with a dense covering of long hairs. Scutellum having long black setae along its posterior margin. This species is closely related to Ch. conops Beck. and Ch. vulpina Mg., but differs from them in having the wing bases and squamae bright yellow.

Male. Face relatively wide, broadening below and covered with a greyish bloom, together with rather long, coarse black hairs; median facial prominence [Fig. 7] relatively wide, strongly projecting; edge of mouth does not extend quite so far forwards as the median facial prominence; genae fairly broad, covered with white bloom and short greyish-white hairs. Eyes with long coarse white hairs.

Frons black with greyish bloom, longitudinally furrowed and covered with long black hairs. Ocular triangle black, with grey-black bloom and long black hairs. Antennae black; third antennal segment small, rounded but with an inconspicuous upper external angle; arista elongate, its basal third somewhat thickened and the proximal half covered with a short fuzz. Scutum and scutellum black, lustrous, with a slight bluish cast and fine spotting; a large patch of silvery-grey bloom occurs along the front edge of the scutum as far as the humoral prominences; scutum with moderately long, erect, black hairs; scutellum with long, erect black hairs and along its posterior margin 14-16 elongate black setae; thoracic walls black, covered with a faint silvery bloom and long black hairs. Limbs black; trochanters (together with apices of femur and bases of tibiae) bright yellow. Wings bright yellow basally; vein m meets $r_{4+5}$ almost at right angles; squamae and halteres bright yellow. Abdomen bronze, lustrous, with only the second tergite dull black in the middle; hairs covering the abdomen bright golden-yellow, rather long, erect; abdomen covered with grey bloom ventrally.

Body length 9—10 mm.

Female not known.

Armenia—Sisnan, near the Shaki waterfall, June 21st 1957 (1 male—holotype; V. Richter). Azerbaidzhan: 13 km. to the west of Yadymlo, Talysh. May 18th, 1959 (1 male—paratype; V. Richter).

Cheilosia portschinskiana Stackelberg, sp. n.

Syn. Cheilosia oestracea L. var. b, c, d, e, f, of Porchinskii, 1877 : 163—164.

Externally this species resembles Ch. illustrata Harr., from which it may be distinguished by the absence of hairs on the face; it is closely related to Ch. nudifacies Beck., described by Becker [1921] and Ch. himalayensis Brun., described under the name Eriozana from the Himalayas by Brunetti [1923]; it may be distinguished from Ch. nudifacies by the shape of its facial profile, which has a feebly projecting median prominence [Fig. 8] and from Ch. himalayensis Brun*, by the reddish-yellow color of the third antennal segment (in Ch. himalayensis the antenna is completely black), also by the light-colored hairy covering of the lower surface of the abdomen—this area is covered with black hairs in Ch. himalayensis.

Male. Frons, clearly protuberant at the level of the antennae, dotted, with smooth longitudinal furrows and a faint greyish bloom; the surface of the frons is glossy and bears long yellowish hairs. Face naked; there is a slight depression below the antennae, a sloping median facial prominence and a distinct prominence at the edge of the mouth [Fig. 8]; the surface of the face is glossy with a faint grey bloom; genae fairly broad (but narrower than the third antennal segment), spotted, with long, sparse white hairs arising from their surfaces; below the eyes there is an anterior patch of black hairs with white hairs posteriorly; the ocular triangle and the upper portion of the occiput are covered with long rust-colored hairs. Eyes with a dense covering of hairs, which on the ventral half of the eyes are white and on the dorsal half are brownish. Antennae short; third antennal segment of insignificant size, rounded; the two basal segments black, the third segment reddish-brown; arista long, with the basal third

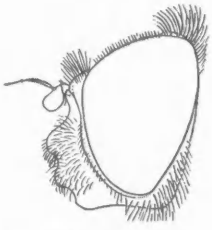

Fig. 7. Cheilosia transcaucasia Stack., sp. n. male. Head in profile.

* This species is known to the author only from its description.

slightly thickened and covered with a short fine fuzz. Thorax black or bronze with a metallic luster, and finely speckled; anterior half of the scutum covered with dense, erect rust-colored hairs, the posterior half with black hairs which are also erect and dense; thoracic walls covered with a grey bloom and anteriorly (mesopleura, pteropleura and upper portion of sternopleura) with long, dense, dirty-white hairs; metapleura and hypopleura naked; pleurotergite with short, dark-brown hairs. Limbs black, trochanters distinctly brownish. Wings transparent, with a brown patch in the center (between veins $r_{2+3}$ $r_{4+5}$ and rm); stigma brown; m joins $r_{4+5}$ almost at right angles; squamae dark brownish-grey, with a black outer margin; short white setules on the squamae and longer dark brown setules on the thorax. Abdomen elongate-oval, black with small speckles, glossy; basal portion of abdomen (first and second tergites) is clothed with long, light yellow (almost white at the sides) hairs; third tergite, for the most part, clothed in long, dense, erect black hairs; distal part of third tergite and all the fourth tergite clothed in dense reddish-yellow hairs; hypopygium with grey bloom and reddish-yellow hairs.

Female. Frons fairly wide with three longitudinal furrows, glossy black, spotted, with a transverse band of grey bloom across its anterior third.

Body length 12—14 mm.

Holotype, male: Kirovakan, Armenia, July 30th, 1959 (1 male; V. Richter); allotype: female, same locality (1 female; V. Richter); paratypes: same locality, July 28th, 30th; August 2nd and 4th, 1959 (5 females; V. Richter).

There is a very considerable variation in the color of the integumentary hairs of this species, a fact which was noticed by Porchinskii [1877], when he described this form as a variety of the widely distributed European species Ch. illustrata Harr. (= oestracea L.). The typical form is as described above; an extreme melanic form (var. d. Porchinskii) is characterized by a covering of black integumentary hairs over the whole of the posterior thorax and the greater part of the abdomen; by contrast, the extreme light-colored form (var. c. Porchinskii) is completely devoid of any black hairs on thorax or abdomen; the thorax is covered with golden-yellow hairs and the abdomen with reddish-yellow hairs. These color forms do not merit subspecific rank, as they are linked together by intermediate forms.

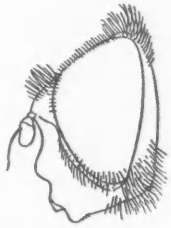

Fig. 8. Cheilosia portschinskiana Stack., sp. n. male. Head in profile.

Neoascia monticola Stackelberg, sp. n.

This species is a close relative of N. dispar Mg. [Stackelberg, 1955a], from which it differs in having the abdomen completely black (without yellow patches) and in having the anterior and middle femora black, except for their apices; the metathorax forms a "waist" behind the posterior coxae; the cross veins of the wings are devoid of dark margins; hypopygium with long white hairs.

Male. The whole of the frons is deeply wrinkled and pitted, bronze in color, glossy, with rather long, erect black hairs; face rather strongly convex anteriorly (as in N. dispar Mg.), completely covered with grey bloom. Antennae with third segment elongately oval, and with the length of this segment twice its width; antennae black, except for the third segment which is reddish-yellow over half its ventral surface. Thorax black; scutum and scutellum coarsely granular, faintly glossy, with short, dense, semi-erect black hairs over portions of the surfaces; posterior portion of scutum and all scutellum covered with rather longer, dark-colored hairs mixed with some lighter ones; thoracic walls black, moderately punctate with metallic luster and a covering of grey bloom; posterior half of mesopleuron, all the pteropleuron and the dorsal part of the sternopleuron clothed in rather long, white, semi-erect hairs. Greater portion of limbs black; apices of anterior and middle femora together with apical and basal third of anterior, middle and posterior tibiae, also second and third segments of anterior tarsi and first three segments of middle tarsi, dark yellow; posterior surface of anterior and middle femora and the whole of the posterior femora covered with rather long, white erect hairs, tibiae and tarsi with short, decumbent, light-colored hairs. Wings transparent; apical sector m (= apical cross vein) forms two right angles, one with the base m and the other with $r_{4+5}$; stigma grey; squamae white with white setules; halteres yellowish-white. Abdomen uniformly black without any yellow markings but with numerous wrinkles and small dots, faintly glossy and covered with hairs, which dorsally are rather short, black and decumbent and at the sides, base and top are white and erect; hypopygium black, glossy, with long white hairs; gonocerci large, irregularly triangular, with drawn-out apices, brown in color and covered with short, erect hairs.

Body length 4 mm.

Female not known.

Holotype: Eastern slopes of the Kapudzhii Mountains, 2500—2700 m. Armenia, August 17th, 1959 (1 male; V. Zaitsev).

Lampetia kiritshenkoi Stackelberg, sp. n.

This highly characteristic species belongs to the same group as L. caerulescens Lw., L. rufipes Sack, and

L. cinerea Mg. [Sack, 1932: 300, §§ 59–61], but is readily distinguished from these forms by the fact that in the former species the eyes are very close together at their nearest point but do not touch.

Male. Vertex, frons and face black, with a bluish cast, metallic luster and finely punctate; height of vertex triangle approximately two and a half times its width along the posterior edge; ocelli arranged in the form of an isosceles triangle, the anterior ocellus being further away from the posterior ocelli than the latter are distant from each other; vertex and frons covered with long, dense, erect black hairs, face with long yellow hairs. The two eyes at their nearest point are as far apart as the diameter of one of the ocelli; eyes with very long, dense black hairs. Occiput relatively wide, covered with a greyish bloom and yellowish-white hairs; antennae moderately long, but not as long as the height of the face, dark yellow in color; second and third antennal segments almost equal in length (third segment hardly noticeably longer); length of third segment approximately twice its breadth; third segment elongately-oval in outline but with a pointed apex; arista distinctly thickened particularly in the proximal half; second segment of arista elongate (approximately twice as long as broad). Thorax blue-black, with metallic luster, finely dotted, with a dense covering of long, erect hairs which are black over the posterior half of the scutum and between the wing bases but light-yellow at the front of the scutum and almost white on the scutellum. Femora black; apices of anterior and middle femora and tibiae and tarsi of all the limbs reddish-yellow, trochanters and posterior pair of limbs with rather long, toothlike projections [Fig. 10]; there is a triangular outgrowth distally on the underside of the posterior femur and this outgrowth has toothlike projections from which arise setae [Fig. 10]; anterior femora with long, erect, fuzzy black hairs posteriorly; posterior femora with long, but not dense, light-colored hairs; tibiae and tarsi with shortish, golden-yellow, decumbent hairs. Wings transparent; bases of wings yellowish; $r_{4+5}$ above $R_5$ with a marked deflection, directed posteriorly and distally; squamae light brownish-yellow; halteres with brown heads. Abdomen blue-black, with rather dense, coarse granulation, faintly glossy, without yellow markings at the side; second and third tergites with faint bands of grey bloom almost parallel with the hind margin of the tergite but not reaching the sides of the abdomen; hairs covering abdomen relatively long, mostly black, semi-erect; lateral margins of abdomen, the patches of bloom and the hypopygium bearing long white hairs.

Body length 7.5 mm.

Holotype: Dargavs, Northern Osetiya, July 24th, 1925 (1 male; Kirichenko).

Penthesilea talyshensis Stackelberg, sp. n.

This species is characterized by the presence of large yellow, translucent patches on the sides of the second and third abdominal tergites [male—Fig. 11] or, in the female, only on the second tergite; there are no transverse bands of grey bloom on the tergites; the tibiae have short decumbent hairs, which are black in the male and light yellow in the female. This species is closely related to P. berberina F. and P. portschinskyi Stack. [Stackelberg, 1955b], from which it differs in the features enumerated above.

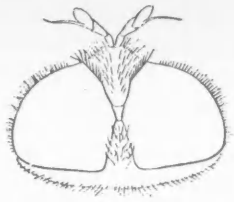

Fig. 9. Lampetia kiritshenkoi Stack., sp. n. male. Head in dorsal view.

Male. Face completely covered with greyish bloom; genae glossy black; frons glossy black with grey bloom laterally and a few colored, erect hairs; vertex long and narrow (its height approximately two and a half times its width at the posterior end), black, with greyish bloom in front of the ocelli and rather long, yellow, erect hairs around the ocelli, eyes in the anterior half of the vertex, closely approximated, lying on the line between the antennal bases, occiput covered with yellowish-grey bloom and light yellow hairs. Antenna brownish-yellow, with a strongly compressed third segment; arista situated near to the base of the third antennal segment and with its basal half somewhat thickened. Scutum and scutellum black, with a bronze cast and covered with a delicate yellowish bloom, which on the scutum forms faint longitudinal stripes; both scutum and scutellum densely covered with long, erect golden-yellow hairs; walls of thorax

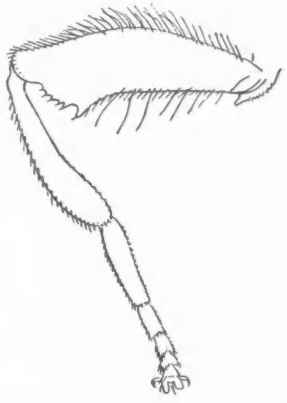

Fig. 10. Lampetia kiritshenkoi Stack., sp. n. male. Hind limb.

with a dense grey bloom and in middle (posterior part of mesopleuron, pteropleura and upper half of sternopleura) with a dense covering of long, fine, fuzzy white hairs. Coxae black with grey bloom; femora black except for distinct yellow apices; tibiae and tarsi entirely yellow; femora bearing short, black, decumbent hairs anteriorly and long, erect, whitish hairs posteriorly. Wings transparent, with their basal parts yellowish, their middle portions (around the veins $r_{2+3}$ and $r_{4+5}$) slightly but hardly noticeably darker; squamae brownish, with golden-yellow cilia; halteres yellow. Abdomen [Fig. 11] short and broad, somewhat wider than the thorax, oval, tapering posteriorly, black, lustrous, with large, dark yellow, translucent, triangular patches at the sides of the second and third tergites; median black longitudinal stripe of tergites 2 and 3 situated between the yellow markings; this stripe occupies about a quarter the width of the tergite in the middle of the latter, but widens sharply in front and behind the middle; posteriorly it almost reaches the lateral margins of the tergite; hairs on the abdomen rather long, dense, erect and uniformly yellow; hypopygium small and black with black hairs.

Female. Face and frons with broad, black, longitudinal stripe. Scutum with four distinct, black, longitudinal stripes. Limbs as in male; tibiae with short, decumbent yellow hairs. Abdomen black, lustrous, second tergite with small, narrow, but rather long, rectangular yellow patches laterally; covering of hairs on abdomen shorter than in male.

Holotype: Alekseevka, Lenkoranskii district, Talysh, May 24th, 1936 (1 male; A. Bogachev); allotype: same locality, May 2nd, 1936 (1 female; A. Bogachev); paratype: same locality, April 25th, 1936 (1 female; A. Bogachev).

## Eumerus armenorum Stackelberg, sp. n.

Abdomen mostly red. Closely related to E. annulatus Pz. and E. sabulonum Fln.; from the first of these the species under consideration may be distinguished by its naked eyes, which lie very close together in the male [Fig. 12] and are approximately a quarter the height of the frons (in E. annulatus Pz. the eyes are densely covered with hairs, are not as near together and their length is approximately equal to the frontal triangle); from E. sabulonum Fln. the species under consideration differs in the black coloration which extends to the base of the tarsi and in the touching of the eyes in the frontal region in the male (in E. sabulonum Fln. the basal joints of the anterior and middle tarsi are yellow and the eyes do not touch in the male, although they lie close together). This species is also closely related to E. tarsalis, from which it differs in the uniform coloration of tarsi, in the absence of large setae, in the feeble development of yellow color at the base of the tibiae (in E. tarsalis approximately one third the total length of the tibiae is yellow) and in the presence of long, white hairs on the middle of the ventral surface of the posterior femur [Fig. 13]; the length of these hairs is greater than the width of the femur itself (in E. tarsalis Lw. the hairs in a comparable position are only half the width of the femur).

Male. Vertex in the shape of a wide isosceles triangle, the height of which is approximately twice the width of the base; black, glossy, with coarse spots, long white hairs anteriorly and long black hairs on the posterior half; ocelli form an isosceles triangle; frons and face covered with whitish bloom and dense, white hairs, decumbent on the frons and erect on the face; frons relatively short (its height approximately equal to the distance from the posterior end of the line of contact between the eyes and the anterior ocellus). Eyes naked and set very close together, the distance between them being a quarter the height of the frons [Fig. 12]; antennae black; third antennal segment short and wide, barely as long as it is broad, with a straight distal edge as though cut across; arista thickened over its basal quarter. Thorax black; scutum with a bluish tinge, covered with dense, coarse granulation, like the surface of a file; scutum faintly glossy and set with very dense, short yellow hairs together with rudimentary bands of grey bloom along the anterior margin; scutellum faintly glossy, coarsely spotted and with similar stripes to those on the scutum; thorax walls medianly (i.e. the hinder half of the mesopleuron, anterior half of pteropleuron and sternopleura) covered with rather long white hairs. Limbs uniformly black; anterior and middle femora covered with rather

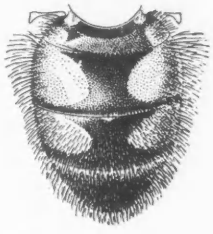

Fig. 11. Penthesilea talyshensis Stack., sp. n. male. Abdomen.

Fig. 12. Eumerus armenorum Stack. Sp. n., male. Head, dorsal view.

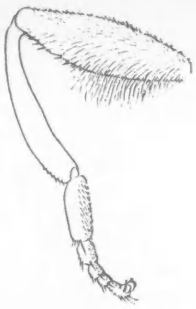

Fig. 13. Eumerus armenorum Stack., sp. n. male. Posterior limb.

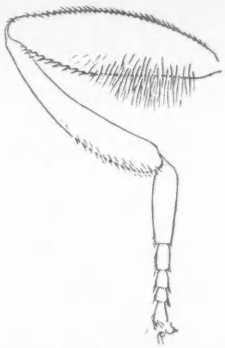

Fig. 14. Eumerus urartorum Stack., sp. n. Hind limb.

long, dense, erect white hairs on their posterior surfaces; posterior femora [Fig. 13] with very long, erect, white hairs ventrally; apical half of posterior femur with two rows of spinules ventrally. Wings transparent; stigma brownish-black; $r_{4+5}$ slightly curved above $R_5$; squamae white with white cilia; halteres yellowish-white. Abdomen dark red; first tergite, except for hind margin, and tergite 4 black; tergites 2, 3 and 4 with crescentic markings of white bloom; hairs covering abdomen short, mostly black, decumbent except on the crescentic markings and laterally where they are white; hypopygium glossy black, with erect, white hairs.

Body length 7 mm.

Holotype: 18 km from Gorisa on the road to Kofan, in the valley of the River Vorotan, Armenia, June 22nd, 1959 (1 male; V. Richter).

Eumerus urartorum Stackelberg, sp. n.

Abdomen red; eyes naked and in the male closely approximated. Antennae reddish-yellow. Posterior femora moderately thickened. This species is closely allied to E. lunatus F., known from Africa, but may be distinguished from the latter by its black limbs (the anterior tarsus is missing in the type specimen), the shorter line of close contact between the eyes in the male, which does not exceed half the height of the frontal triangle (in E. lunatus F. this line of contact approximately equals the height of the frontal triangle), and the moderately thickened posterior femur [Figs. 14, 15].

Male. Face and frons covered with grey bloom and rather long white hairs; triangle of vertex rather wide, black, with coarse dense spotting and small ridges, faintly glossy with white, erect hairs over its anterior third and black, erect hairs posteriorly; height of vertex two and a half times its width between the ocelli; ocelli arranged in the form of an equilateral triangle—distance between anterior ocellus and posterior ocelli somewhat greater than the distance between the two posterior ocelli; eyes naked, their line of contiguity rather less than half the height of the frontal triangle. Basal antennal segment brownish-black, third segment large, yellowish-red and broad (length exceeds breadth by approximately a quarter) with the distal end truncate, an obtuse upper and more acute lower angle; arista distinctly thickened distally. Thorax black; scutum with coarse granulation, rather like the surface of a file in places, slightly glossy, with short, dense, erect yellow hairs; the anterior half of the scutum has two bands of white bloom which gradually narrow as they approach the posterior edge and barely reach the transverse suture; scutellum large, with abundant coarse spotting, slightly glossy; on the posterior half of the mesopleuron, on the pteropleuron and on the sternopleura are rather long white hairs. Limbs black with short decumbent hairs; anterior and middle femora with erect white hairs posteriorly; posterior femora with similar erect hairs on both surfaces; posterior femora moderately thickened, with two rows of large, pointed spinules on the distal half of its underside. Wings transparent; stigmata dark grey; $r_{4+5}$ distinctly curved above $R_5$; squamae white with white cilia; halters light-yellowish. Abdomen dark red all over (except for the anterior edge of the first tergite which is black) with abundant coarse spotting, faintly glossy, with short, decumbent, mainly black hairs; tergites 2—4 with wide, rather indefinite, crescentic areas of white bloom, covered with white hairs; proximal part of the abdomen, together with its sides and ventral surface covered with rather long, erect, white hairs; hypopygium black, glossy, with moderately long, erect, black hairs; sternite 4 with an arciform notch on its hinder margin; gonocoxites rather wide, slightly expanded distally, with truncate ends.

Body length 9 mm.

Holotype: 18 km from Gorisa, in the valley of the River Vorotan, Armenia, June 22nd, 1959 (1 male; V. Richter).

Eumerus richteri Stackelberg, sp. n., male and female [Fig. 16].

This species is allied to E. rusticus Sack, from which it is distinguished by the following features: the

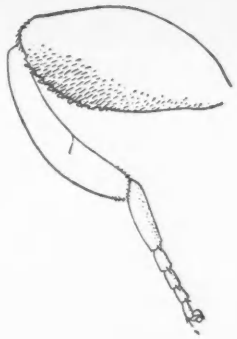

Fig. 15. Eumerus lunatus
F. Male. Hind limb.

ocelli being arranged in the form of an isosceles triangle - the front ocellus being at a greater distance from either posterior ocellus than the two latter ocelli are from each other (in E. rusticus the ocelli are arranged in the form of an equilateral triangle); the eyes are covered with long, dense white hairs (in E. rusticus the eyes have short hairs); the third antennal segment is relatively broad, elongate and with a truncate apex (in E. rusticus the third antennal segment is elongate oval, with a non-truncate apex); the posterior femora are moderately thickened and the posterior tibiae are almost straight (in E. rusticus the posterior femora are markedly thickened, and the posterior tibiae are strongly curved).

Male. Head large, wider than thorax. Face not broad, widening slightly ventrally, dark metallic blue in color, covered with greyish bloom and long, coarse white hairs; frons forming a narrow isosceles triangle, glossy black, transversely striated with long white hairs. Eyes at their nearest proximity are separated by a distance approximately equal to the width of 3–5 facets; vertex forms a tall triangle (height approximately two and a half times the width of the base), glossy black, the anterior third covered with grey bloom; ocelli arranged in the form of an isosceles triangle (the anterior ocellus separated from either posterior ocellus by a distance one and a half times that separating the two posterior ocelli); vertex covered with long dense white hairs. Antennae of moderate size; first and second segments short, dark brown with white setae and hairs; third segment elongate-oval, somewhat expanded distally and with a truncate apex, yellowish-red; its length approximately one and a half times its width; arista with its basal quarter stouter than the rest; occiput expanded over its dorsal portion behind the eyes, glossy black. Scutum blue-black, glossy, with rather large spots and with two longitudinal stripes of white bloom, gradually tapering posteriorly and not quite reaching the scutellum; the whole of the scutum covered with rather long, dense, erect, white hairs; scutellum of same color as scutum and with long, erect, white hairs; posterior margin distinctly fringed with cilia; thoracic walls blue-black with a metallic luster and long, white hairs, except for anterior half of the mesopleuron, hypopleura and metapleura, which are bare. Limbs black, with metallic luster; trochanters, proximal portions of all tibiae and ventral side of tarsi yellow; no sharp boundary between yellow and black coloration in tibiae; posterior femor visibly but not markedly thickened, straight, their antero-ventral surfaces bearing a comb set with large, pointed spinules, 8–10 in number; posterior tibiae gradually thickening toward the apex, slightly curved, with transverse ridges on the middle of their inner surfaces; hairy covering to limbs white. Wings transparent, with basal venation yellow and the rest of the veins black; $r_{4+5}$ above cell $R_5$, distinctly curved; apical sector m bent

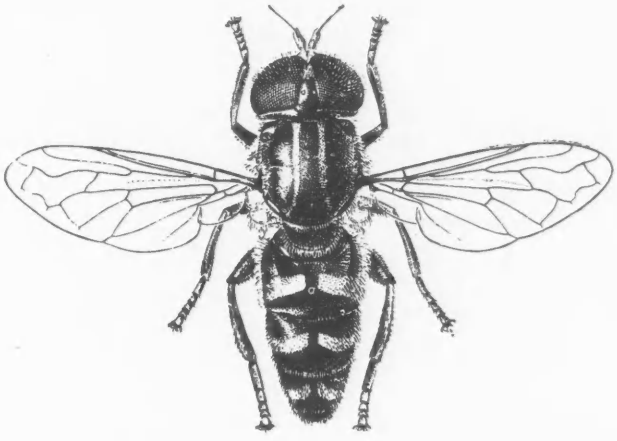

Fig. 16. Eumerus richteri Stack., sp. n. male.

into an S-shaped curve. Abdomen glossy black, with coarse, abundant spotting and with three pairs of rather broad, crescentic patches of white bloom on second, third and fourth tergites; dorsal surface of abdomen for the most part covered with black, decumbent hairs; patches of white bloom on lateral portions of abdomen covered with white hairs; hypopygium black, with white hairs; gonocoxites long, somewhat expanded distally with blunt apices.

Female. Frons relatively narrow, approximately one-sixth the width of the head, slightly tapering posteriorly, glossy black, with coarse spotting and moderately long, erect, light colored hairs, together with narrow bands of white bloom along the margins of the eyes. For the rest, like the male.

Length 9—11 mm.

Holotype male and paratype male: Lyaketag village, Dzhul'finsk district, Nakhichevansk Autonomous SSR, June 30th, 1959 (2 males; V. Richter). Allotype female: Arafsa, Nakhichevansk Autonomous SSR, June 30th, 1959 (L. Zimina).

This species is named in honor of Andrei Andreevich Richter, who has done so much toward furthering research into the insect fauna of Transcaucasia.

## SUMMARY


Pipizella curvitibia Stack., sp. n. Larger species (9 mm). Male middle tibiae distinctly curved and moderately thickened (Fig. 3). Wing bases yellow. Female second antennal joint long (Fig. 4).—Transcaucasus.

Cheilosia armeniaca Stack., sp. n. Allied to Ch. caerulenscens Lw., Ch. kerteszi Szil. and Ch. helvetica Wainwr., but scutellum without black marginal bristles, mesonotum with long erect greyish white hairs, hind femora in apical half below with two rows of black bristly hairs and abdomen short oval [Fig. 6].—Armenia.

Cheilosia transcaucasia Stack., sp. n. Allied to Ch. conops Beck. and Ch. vulpina Mg., but wing bases brightly yellow.—Transcaucasus (Armenia, Azerbaidjan).

Cheilosia portschinskiana Stack., sp. n. Similar to Ch. illustrata Harr., but larger and with bare face. Allied to Ch. nudifacies Beck. and Ch. himalayensis Brun., but face in profile another shape [Fig. 8], 3rd antennal joint reddish brown and abdomen below pale-haired.—Armenia.

Neoascia monticola Stack., sp. n. Allied to N. dispar Mg. (Stackelberg, 1955a), but male abdomen entirely black, front and middle femora mainly black, hypopygium long white haired.—Armenia.

Lampetia kiritshenkoi Stack., sp. n. Allied to L. caerulescens Lw., L. ruficpes Stack., and L. cinerea Mg. (Sack., 1932: 300 §§ 59—61), but male eyes distinctly separated [Fig. 9].—Caucasus (North Ossetia).

Penthesilea talyshensis Stack., sp. n. Allied to P. berberina F. and P. portschinskyi Stack. (Stackelberg, 1955). Male abdomen with large yellow lateral spots on the 2nd and 3rd tergites [Fig. 11]; female abdomen with smaller spots only on the 3rd tergite; male and female abdomen without greyish dusted stripes.—Transcaucasus (Talysh).

Eumerus armenorum Stack., sp. n. Abdomen red. Allied to E. annulatus Pz., E. sabulonum F. and E. tarsalis Lw., but eyes bare, in the male touching in a very short distance, and front and middle tarsi all black.—Armenia.

Eumerus urartorum Stack., sp. n. Abdomen red. Allied to E. lunatus F., but hind femora moderately thickened. Antennae reddish yellow.—Armenia.

Eumerus richteri Stack., sp. n. Allied to E. rusticus Sack, but ocelli disposed in an isosceles (not equilateral) triangle, eyes densely long haired, 3rd antennal joint broad, hind femora moderately thickened and hind tibiae nearly straight.—Transcaucasus (Nachitshevanj).


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# THE SPECIES OF THE GENUS MEROMYZA MEIG. (DIPTERA, CHLOROPIDAE) FROM THE ENVIRONS OF MOSCOW

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The genus of flies Meromyza, together with such species as Chlorops and Oscinella, are widely known because a few of the species are serious pests of grasses. Besides that, the genus occupies a primary position among the Chloropidae by reason the numerical abundance of the species. Nevertheless, the members of the genus Meromyza are not sufficiently studied. Even the very complete resume of A. A. Shtakel'berg (1933, 1958) contains only three species of Meromyza. Meanwhile, the study of only one of the sub-Moscow faunas showed the presence of nine species of the genus differing widely in their ecology; four of them proved to be new species. In the literature devoted to the meromyzids connected with agriculture, the confusion in the systematics of the genus has led to the fact that in all the published work, including that of such well-known authors as C. K. Tsygankov (1930), A. Ya. Leskov (1953) and others, only M. saltatrix L. appears as the most well-known and widespread species. Nevertheless, we have reason to suppose that under the name M. saltatrix L. a complex of species is, in the majority of instances, involved because the ecological patterns given by the authors apply to other species and are not peculiar to M. saltatrix L.

The old authors—Meigen (1830, 1838), Macquart (1835), Zetterstedt (1848) and Shiner (1864)—cited six species of Meromyza in the European fauna:— M. saltatrix L., M. pratorum Meig., M. laeta Meig., M. variegata Meig., M. nigriventris Macq. and M. femorata Macq. In later works some of the species mentioned were reduced to the level of synonyms, others were taken to be varieties. Thus, Bekker (1905—1910) assimilated M. laeta and M. variegata into one species, taking the first to be a synonym of the second, but M. nigriventris and M. femorata were assumed to be varieties of M. saltatrix and M. variegata respectively. Duda (1933) came to the conclusion that among the authentic species it was possible to include only M. pratorum and M. saltatrix and, in general, the other species were either not mentioned or were assumed to be varieties of M. saltatrix. The principal characters taken into consideration by Duda in determining meromyzids appear to be color and markings. The morphology of the genitalia was not studied by any of the authors mentioned. Particulars of the ecology of the species were, in general, not taken into account.

In the study of the meromyzids of Moscow we relied, first and foremost, on the differences in structure of the male genitalia because this complex of characters appears to be the most permanent. Having established the differences in the morphology of the genitalia we were able to define the limits of variation in this and other characters—that of color and markings, the shape of the femora, the width of the jowl, etc. We supplemented the morphological differences of the species with particulars about their ecology.

The structure of the male hypopygium is represented in Fig. 1. In the front plane the parameres of the ninth tergosternite are visible which, in the normal position, are drawn within the hypopygium. The parameres are stout, strongly sclerotized formations, black or brownish in color; their shapes and dimensions are different in the various species and were used by us in determining the species. The parameres consist of two parts—an anterior and a posterior, which we have named anterior and posterior parameres; the anterior parameres are always larger than the posterior and point downwards and forwards while the posterior are most often directed straight downwards.

The collections of insects made during the summer seasons of 1957 and 1958 in the Chashnik district of the

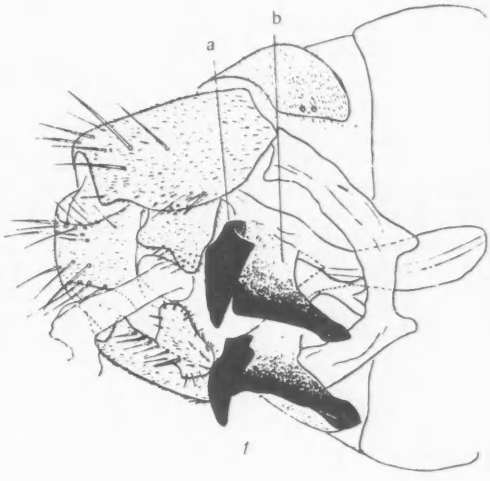



Fig. 1. Structure of the hypopygium of Meromyza saltatrix L. a) Posterior parameres; b) anterior parameres.

Moscow region, as well as the collections from the neighborhood of Zvenigorod and the valley of the Moscow River, served as the material for the present work. Besides that, material was obtained from the neighborhood of the village of Arkanov and the stations on the Zalenogradsk–Yaroslav railway. The insects were collected by sweeping with an entomological net every three days from the beginning of June to the end of August. In this way various stages were obtained. Over 4000 specimens of meromyzids in all were collected in Chasnik and there is an adequate quantity of material from each species.

I sincerely thank E. S. Smirnov for the assistance he has given me in this work.

## IDENTIFICATION TABLE FOR THE SPECIES OF MEROMYZA

1 (6). Palps entirely light or slightly brownish at the very tip.

2 (3). Central stripe on mesonotum is not continued on to the scutellum; sometimes a yellow longitudinal line is seen on the middle of the scutellum. Width of the posterior femora is more than twice the width of the posterior tibia. Palps light, thin. Length of frontal triangle almost equal to its base. Occiput usually without a dark mark. Hairs on the lower edge of the gena more often black, sometimes white. Stripes on mesonotum brownish, sometimes black; central stripe, as a rule, does not reach the scutellum. Abdomen greenish, generally entirely without markings (except the lateral spots on the 2nd segment which are always present); sometimes there is a central, discontinuous stripe. The anterior parameres gradually narrow toward the tip, directed forwards; the posterior parameres elongated, pointing downwards (Fig. 2). Length 4–5 mm. . . . . 1. M. variegata Meig.

3 (2). Central stripe on mesonotum continues on to the scutellum. Width of posterior femora is less than twice that of the posterior tibia.

4 (5). Frons projects well beyond the front of the eyes so that the profile of the face is strongly curved; the curved suture on top, under the antennae, slightly darkened. Length of frontal triangle always greater than its base. Stripes on the mesonotum black, quite narrow. Abdomen light, not shining long; tips of hind femora reach only as far as the middle. Palps light, thin. The smooth basal part of the frontal triangle merges into a wrinkled part of the apex. The pattern on the occiput is weakly marked, more often entirely absent. Hairs on the lower edge of the gena light or black. Stripes on the mesonotum always isolated from one another, the middle one passing over on to the scutellum. Hind femora comparatively thin, their width not more than twice the width of the hind tibia. Abdomen generally light yellow with one or three longitudinal stripes, or without any. Parameres brown, the anterior with wide bases and the distal ends with wide furrows formed at the expense of a recurved outer edge; posterior parameres in the form of wide semicircular blades abutting against the outside of the anterior parameres (Fig. 3). Length 4–5 mm. . . . . 2. M. pratorum Meig.

5 (4). Frons projects slightly in front of the eyes so that the profile of the face is almost rectilinear. Curved suture not darkened. Length of frontal triangle less than its base, or equal to it. Stripes on the mesonotum black or brown, wide. Abdomen shining, partly black, short; tips of hind femora extend far beyond its middle, sometimes reaching the end. Palps thin, the ends sometimes brownish. Frontal triangle has a wrinkled area in the form of a rhombus on its apical part which is rather darker in color than the basal part and is abruptly separated from it. Markings on the occiput generally consist of an oblong, central spot and a longitudinal stripe on each side; in dark specimens the whole occiput is black. Hairs on the lower edge of the gena white. The stripes on the mesonotum fuse with one another anteriorly. The scutellum often has a wide stripe. Abdomen with three black, longitudinal, interrupted stripes which are often fused in a transverse direction. The end of the abdomen in the female is slightly compressed laterally, the tip of the last sternite rather pointing downwards and backwards. Parameres black, the anterior with narrow bases and the distal ends in the form of a triangle; the posterior parameres narrow, pointed at the end and inclined slightly forwards (Fig. 4). Length 3–3.5 mm. . . . . 3. M. mosquensis, sp. n.

6 (1). Palps blackened as far as the middle or beyond.

7 (8). Posterior femora very stout, being more than twice the width of the hind tibia. Stripes on the mesonotum orange or yellowish. Anterior parameres notched at the end (Fig. 5). Length 4.5–5 mm. Palps blackish, thin. Frons and jowl extend in front of the eyes less than the width of 3rd antennal joint. Length of frontal triangle scarcely longer than its base. Occiput light, sometimes with two yellowish, longitudinal stripes on the side. On the lower edge of the gena are black or white hairs. Stripes on the mesonotum wide. Abdomen greenish-yellow on top with one central stripe, sometimes additional later-

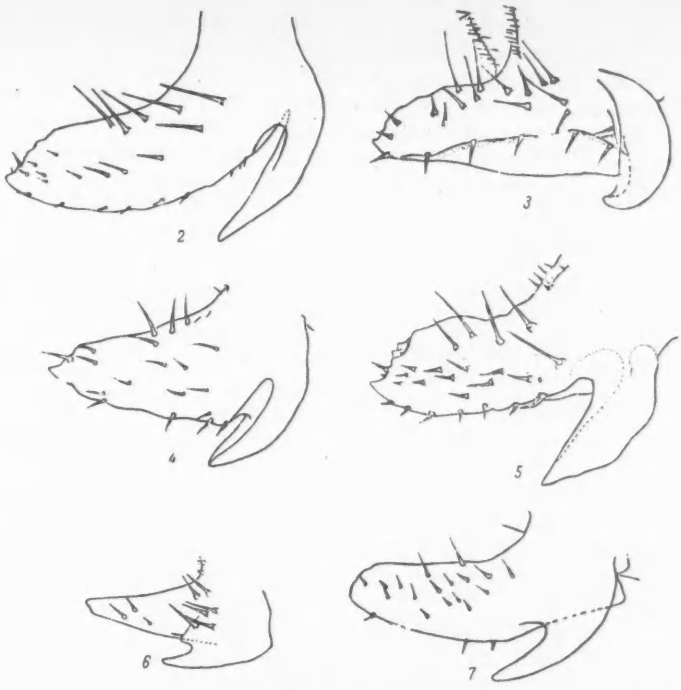


Fig. 2–7. Parameres of the male: 2) Meromyza variegata Meig.; 3) M. pratorum Meig.; 4) M. mosquensis, sp. n.; 5) M. femorata Macq.; 6) M. triangulina, sp. n.; 7) M. laeta Meig.

al spots on the last segment; the markings are rarely completely absent. Anterior parameres of the hypopygium with three to four teeth at the base and a longitudinal rib in the middle; posterior parameres stand out from the anterior, long, sharp at the end. (Fig. 5). . . . . 4. M. femorata Macq.

8 (7). Width of posterior femora less than twice the width of the hind tibia. Stripes on the mesonotum black, if they are light, then the posterior femora are thin and the parameres are not notched at the end. Length less than 4.5 mm.

9 (10). Hairs on the lower edge of the gena black. Edges of frontal triangle dark. Palps black, more or less dilated. Frons and jowl project beyond the eyes less than the width of the 3rd antennal joint. Length of frontal triangle scarcely longer than the base. Frons and vertex often darker than the frontal triangle. Occiput with a distinctly dark mark, sometimes completely black. Stripes on the mesonotum black; central stripe often narrows anteriorly and always passes over on to the scutellum where it sometimes becomes brownish. Width of hind femora more or less twice as wide as the hind tibia. Abdomen, as a rule, with three black, longitudinal, interrupted stripes which often coalesce in a transverse direction. Parameres very small, the anterior and posterior more or less similar in shape and size, triangular; the anterior parameres directed forwards, the hind ones somewhat to the side (Fig. 6). Length 2.5–3.5 mm. . . . . 5. M. triangulina, sp. n.

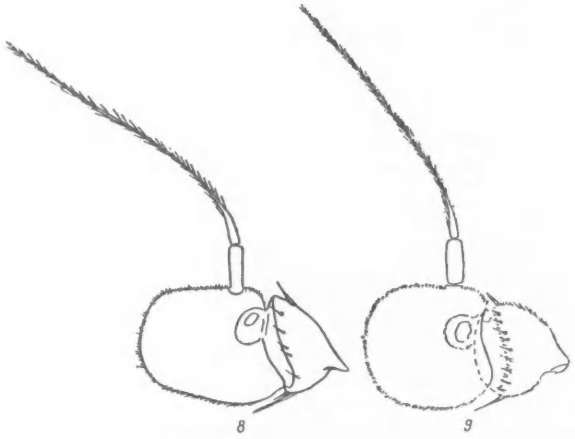
10 (9). Hairs on the lower edge of the gena light.* Edges of frontal triangle uncolored or slightly darkened.

11 (14). Stripes on the mesonotum are sometimes not completely black, usually bi-colored, rarely uniformly yellow.

12 (13). Length of 3rd antennal joint rather greater than its width. Palps thin, not foliaceous. Frontal triangle slightly wrinkled on its apical half, the edges sometimes darkened and always clear. Width of hind femora more than twice that of the hind tibia. Along the central stripe of the mesonotum the brown color is predominated by black. Palps black. Frons and jowl extend beyond the eyes more than the width of the 3rd antennal joint. Length of frontal triangle equal to, or rather more than, its base. Occiput com-

*If there is a mixture of black hairs, then the frontal triangle has no black border.

pletely white to completely black. Hairs on the lower edge of the gena light. Color of the stripes on the mesonotum varies; more often the lateral stripes are black and the central one entirely or partly brownish; it is seldom that all the stripes are brown or yellow with washed-out edges. Sometimes the central stripe does not extend to the hind edge of the mesonotum, but the scutellum always has stripes. Abdomen with one or three longitudinal, brown stripes which often coalesce in a transverse direction. Parameres large in the middle; the anterior are not bent downwards and the ends not narrowed; the posterior are pointed at the end; both point downwards and forwards (Fig. 7). Length 3—3.5 mm. . . . . 6. M. laeta Meig.



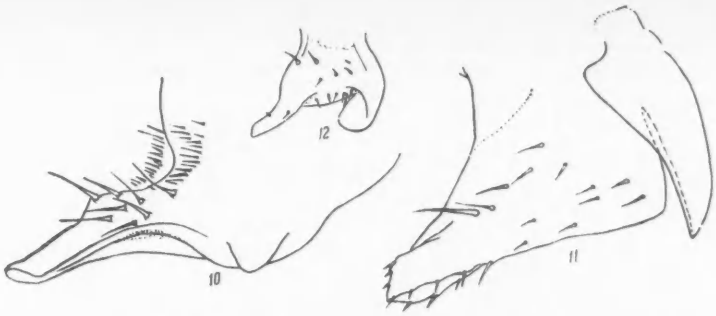

Figs. 8—9. Antennae of the male (2nd—3rd joints): 8) Meromyza nigriventris, sp. n.; 9) M. saltatrix L.

13 (12). Third joint of antenna not longer than wide, rounded below. Palps enlarged, foliaceous. Frontal triangle shining, without borders. Width of posterior femora not more than twice the width of the hind tibia. Along the central stripe of the mesonotum black predominates. Palps black. Frons projects slightly, jowls very narrow. Edges of frontal triangle clearly marked in the apical half; length of the frontal triangle longer than, or equal to, its base. Ocellar spot often very large, sometimes fused with the occipital spot. Occiput light-colored to almost completely dark. Hairs on the lower edge of the gena light. Stripes on the mesonotum quite wide, black, the middle one on the scutellum sometimes brownish in the middle. Hind femora thin, their width not more than twice the width of the hind tibia. Abdomen with three dark stripes which are often fused transversely. Parameres very small, the anterior saddle-shaped underneath in front, the tip narrow and elongated; the posterior parameres quite wide, rounded at the end (Fig. 12). Length 2.5—3.5 mm. . . . . 7. M. palposa, sp. n.

14 (11). Stripes on mesonotum black, always of one color.

15 (16). Third antennal joint oblong, its lower edge almost straight (Fig. 8). Ocellar spot fused with the occipital spot which has a triangular of rhomboidal shape, reaching the middle of the occiput; isolated specimens with the occiput entirely light. Last segment of abdomen of the male with long black bristles. Palps black, thin. Frons and jowl project in front of the eyes to a distance less than the width of the 3rd antennal joint. Length of frontal triangle no greater than the base. On the occiput, in addition to the central triangular or rhomboidal spot, there are sometimes two longitudinal, lateral stripes and a single round spot on the shoulder. Hairs along the lower edge of the gena white. Stripes on the mesonotum narrow, black,† middle one passes over on to the scutellum. Width of hind femora more than twice the width of the hind tibia. On the top of the abdomen there is one, more rarely three, longitudinal

†In specimens found in North Kazazhstan the anterior portion of the middle stripe is brown.




Figs. 10—12. Parameres of the male: 10--Meromyza nigriseta, sp. n. 11—M. saltatrix L. 12—M. palposa, sp. n.

stripes. Parameres of hypopygium brown; the anterior being wide at the base and has the distal half bent in the form of a slightly curved tube; the posterior are very small, completely dissolving into the anterior from the outer side and have a hemispherical shape (Fig. 10). Length 3—4 mm. . . . . 8. M. nigriseta, sp. n.

16 (15). Third joint of antenna no longer than wide, rounded below (Fig. 9). Between the ocellar and occipital spots there is a light stripe; the occipital spot is not triangular. The last segment of the abdomen has short, light hairs. Palps black, slightly dilated. Frons and jowl project beyond the eyes to a distance less than the width of the 3rd antennal joint. Length of frontal triangle equal to its base. Occiput with variable markings—from entirely black to completely white. Hairs on the lower edge of the gena usually white. Stripes on the mesonotum black, the middle one extending on to the scutellum. Upper surface of the abdomen with three longitudinal, black stripes which are sometimes fused in a transverse direction; less often with one stripe. In dark specimens the whole of the abdomen, the occiput and the frontal triangle are black. Parameres very stout; the anterior are trapezoidal with a dorso-ventrally flattened, anterior, lower end; posterior parameres quite wide, pointed at the end (Fig. 11). Length 3—4 mm. . . . . 9. M. saltatrix L.

## DESCRIPTION OF NEW SPECIES

### Meromyza nigriseta Fed., sp. n.

Greenish color.

Head. Second and third antennal joints light, darkened above. Third joint quadrangular in shape with rounded corners, its length somewhat greater than its width. Palps light, the distal half black, cylindrical, slightly expanded at the tip. Length of the projecting part of the frons and the width of the jowl less than the width of the 3rd antennal joint. Hairs on the lower edge of the gena white. Apical half of the frontal triangle slightly wrinkled, its length scarcely greater than its base. Ocellar spot quite large, round or pointed in front; posteriorly it fuses with the occipital spot. Occipital spot black or brown, generally triangular in shape, the tip being directed backwards and reaching only to the middle of the occiput, less often rhomboidal in shape. On both sides of the occipital spot there is sometimes a longitudinal, cuneiform stripe and round lateral spots.

Thorax. Stripes on the mesonotum black; the middle one seldom brown in front and always extends on to the scutellum. Legs light, tarsi often entirely or partially darkened. Width of posterior femora not greater than three times the width of the hind tibia.

Abdomen elongated, with one, less often with three, longitudinal stripes; the lateral ones may be present only on the last segment. The last segment of the male with long black bristles. Anterior parameres brown, narrow with middle part bent into a saddle shape with blunt ends; hind parameres very small, hemispherical (Fig. 9). Length from 3.5—4 mm.

Collected in large numbers in Chasnik in the neighborhood of Zvenigorod in 1957 and 1958 (males and females). It flies from July 12th to March 7th. The type is in the collection in the Zoological Institute AN USSR in Leningrad.

It is, apparently, confused with M. saltatrix to which it is related but differs from it in a number of characters. The principal characteristic of our species is reflected in the name,—the presence of black, well-marked bristles on the genital segment of the male; the anterior parameres are weakly sclerotized, narrow and slightly bent lengthwise; the posterior are diminutive. In M. saltatrix the end of the abdomen in the male carries light hairs; the anterior and posterior parameres are very sturdy and wide. Besides that, the 3rd antennal joint of our species is rather bent along its length, its lower edge being almost straight and in M. saltatrix it is not longer than its width

and is rounded below. Lastly, between the ocellar and occipital spots in the typical form of M. nigriseta there is no light stripe, and the latter spot is always triangular or rhomboidal. The markings on the occiput of M. saltatrix are very variable, but there is always a gap between the ocellar and occipital spots.

Meromyza triangulina Fed., sp. n.

Yellowish color.

Head. Third antennal joint light, darkened above; its length approximately equal to its width, sometimes rather exceeding the preceding joint, its lower edge rounded. Palps more than half black, cylindrical. Length of projecting part of the frons and the length of the jowl are less than the width of the 3rd antennal joint. Hairs on the lower edge of the gena black. Frons and vertex generally brownish, darker than the frontal triangle; edges of the frontal triangle very darkened and, therefore, stand out sharply against the background. Length of the frontal triangle longer than, or equal to, the base. Ocellar spot quite large, round, partly fused with the central occipital spot. The latter often has a triangular or rectangular shape; along the sides there are sometimes longitudinal stripes. Sometimes the whole occiput is black.

Thorax. Stripes on the mesonotum black. Very rarely the middle stripe is partly brownish; it is usually slightly contracted beyond the middle, but it always passes over on to the scutellum. Legs light, the anterior femora and tarsi occasionally darkened. Hind femora very thin, their width scarcely more than twice the width of the posterior tibia.

Abdomen, as a rule, with three longitudinal black stripes which sometimes coalesce in a transverse direction; rarely there is only one longitudinal stripe. The tip of the abdomen of the male is covered with long dark hairs. The anterior and posterior parameres are similar in shape and size, not large, triangular; posterior somewhat shorter but wider than the anterior; the anterior parameres directed forwards and downwards, the posterior rather to the side. Length 2.5– 3 mm.

Collected in 1957 and 1958 in Chasnik (males and females). It flies from July 5th to August 20th. The type is in the collection of the Zoological Institute AN USSR in Leningrad.

This species, probably, is also one of the species complex, being mistaken for M. saltatrix. In the meantime our species differs from the latter in all the essential characters. The sharp outlining of the frontal triangle, the black hairs on the gena and the very thin hind femora of our species easily permits us to distinguish it from M. saltatrix. Besides that, the parameres of M. triangulina are quite different from the type; they are very small and both of triangular form; in M. saltatrix the anterior parameres are trapezoidal, but the posterior are blade-shaped; both are very sturdy.

Meromyza mosquensis Fed., sp. n.

Greenish-yellow color.

Head. Third antennal joint almost entirely dark on the outside, but on the inside dark only at the tip; its lower edge usually round, seldom straight. Palps light, sometimes light brown at the very tips. Frons projects slightly so that the profile of the face is almost rectilinear. Jowls quite wide, although the width is always rather less than that of the 3rd antennal joint. Apical half of the frontal triangle has a wrinkled surface of rhomboidal shape, often rather darker in color than the basal portion. Ocellar spot often fused with the spot on the occiput. Markings on the occiput variable; often there is a longitudinal, central mark and narrow stripe at the side; sometimes these marks fuse and in that case the middle of the occiput is dark; in dark individuals the whole occiput is black. Hairs on the lower edge of gena are light.

Thorax. Stripes on the mesonotum are black or dark brown, wide, their anterior ends often touching one another. Scutellum with a wide, more often dark brown, stripe. Anterior femora sometimes darkened; hind femora quite stout but their width is always less than twice that of the hind tibia.

Abdomen is quite short so that the tips of the hind femora reach beyond its middle, sometimes reaching the tip. Upper surface of the abdomen shining, frequently with black shoulder stripes on each segment, sometimes with three interrupted, longitudinal stripes. End of abdomen of female slightly compressed laterally; tip of last sternite projects somewhat downwards and backwards. Genital segment of male generally bent strongly downwards. Parameres black; the anterior with narrow bases, the distal half triangular; the posterior narrow, pointed at the end and inclined forwards (Fig. 4). Length from 3–3.5 mm.

Found in large numbers in Chasnik Moscow region in 1957 and 1958 (males and females). It flies from June 27th to August 18th. The type is in the collection of the Zoological Institute AN USSR in Leningrad.

It is allied to M. variegata Meig. and differs from it in the presence of a wide stripe on the scutellum, the darker color of the stripe and marking on the occiput, the thinner hind femora and also by the peculiar structure of the end of the abdomen in both sexes. The size of the body of our species is smaller than that of M. variegata.

Very dark specimens of M. mosquensis with a black, shiny abdomen and dark, wide thoracic stripes remind one of M. nigriventris Macq.‡ The latter, however, differs from our species in the black color of the palps and the

‡ M. nigriventris Macq. is absent from the Moscow region. We observed this species in collections from Krasnodarsk region and the Ukraine. The principal characters of this species are:—palps wide and more than half black; ocellar spot occupies almost the whole of the base of the frontal triangle; occiput almost entirely black, thoracic stripes black and very wide; abdomen black on the top, shining; parameres small, the anterior being triangular in shape with a slightly bent, lower, anterior end.

darker color of all the markings and also in the shape of the parameres.

Meromyza palposa Fed., sp. n. male.

Yellow color.

Head. Third antennal joint light, slightly darkened above and with a small hollow, rounded beneath; its length less than, or equal to, its width. Palps black almost to the base, leaf-like, fairly wide. Frons projects slightly; jowl quite narrow, so that the length of the projecting part of the frons and the width of the jowl are less than the width of the 3rd antennal joint. Width of gena no more than twice the width of the jowl (both measured in the middle). Limits of the frontal triangle in the apical part not clearly defined. Length of frontal triangle greater than, or equal to, its base. Vertex, in front of the ocellar spot, rather protrudes (seen in profile). Ocellar spot quite wide and sometimes fused with the occipital. Occipital spot rarely occupies the whole occiput; more often it is in the form of a weakly marked, lateral, longitudinal stripe. Hairs on the lower edge of the gena light.

Thorax. Stripes on the mesonotum wide in front and narrowed at the end, black; central stripe in the region of the scutellum, and also sometimes in the middle of the mesonotum, brownish. Legs yellow; sometimes the anterior femora and tarsi are darkened. Hind femora very narrow, their width not more than twice the width of the hind tibia.

Abdomen. There are, generally, wide, dark shoulder stripes on all segments. On the last abdominal segment of the male the hairs are white. Parameres of the hypopygium brown, very small; anterior and middle parts quite wide, bent into a saddle shape and narrow at the end; posterior parameres wide, hemispherical (Fig. 12). Length 2.5–3.5 mm.

Three specimens were caught by E. S. Smirnov: two on July 29, 1951 in the environs of Strunino, Vladimir region and one on June 21, 1953 in Zelenogradsk, Moscow region. I found one male on July 25, 1957 in Chasnik. The type is in the collections of the Zoological Institute AN USSR in Leningrad.

According to the character and color of the stripes of the mesonotum, the size of the body, the width of the hind femora and the structure of the hypopygium, it is more closely related to M. triangulina, sp. n. It differs from M. triangulina in the white color of the hairs on the gena, the wide palps and the uncolored frontal triangle.

## SYNOPSIS OF THE SPECIES OF MEROMYZA

In this synopsis short accounts of the systematics and ecology of the species under discussion are given.••

M. pratorum Meigen, 1830.

Macquart, 1835; Zetterstedt, 1848; Walker, 1853; Schiner, 1864; Becker, 1900, 1910; Duda, 1933;—viridula Haliday, 1833.—decora Frey, 1907.

It is easily recognized by the strongly projecting frons and wide jowls. The palps, as a rule, are light, strongly darkened at the very tip only in isolated individuals. This latter character caused Duda to assume that decora Frey was a variation of M. pratorum Mg.

It flies from June to September in small numbers; it is met with in various stages and is predominant in littoral situations. The larvae develop in the stems of tufted hair-gras (Deschampsia caespitosa L.).

Occurrence: The regions of Ukraine, Voronezh, Moscow, Leningrad, Kustanay, Kemerova, Akmolinsk, Tuben Aut. and Kirghiz.

M. Saltatrix Linné, 1761, 1766 (Musca).

Fallén, 1820 (Oscinis); Meigen, 1830; Macquart, 1835; Zetterstedt, 1838, 1848; Walker, 1853; Schiner, 1864; Becker, 1910; Duda, 1933;—clavicrus Gmelin, 1793 (Musca).—minuta Fabricius, 1794 (Musca).—viriscens v. Roser, 1840.

We adopt this species from Meigen, Tsetterstedt, Schiner, Becker and Duda (saltatrix forma typica), insofar as the descriptions of these authors agree on the essential features. In his description Linnaeus did not notice the stripe on the scutellum.

A very common species. It prefers dry, elevated localities and is found along the sides of roads and on the borders and boundaries of fields. It flies from the beginning of June until the 3rd week in July; in some years a partial second generation is produced. The larvae are found in the stems of the smooth-stalked meadow grass (Poa pratensis, L.).

Occurrence: Ukraine, and the regions of Krasnodarsk, Moscow, Leningrad, Kemerov, Chelyabinsk, and Akmolinsk.

M. variegata Meigen, 1830.

Macquart, 1835; Zetterstedt, 1848; Walker, 1853; Schiner, 1864.—rufescens v. Roser, 1840.—variegata var. femorata Becker, 1910.—saltatrix var. variegata subvar. femorata Duda, 1933.

We accept this species in accordance with the descriptions by Meigen, Schiner and Tsetterstedt. Becker identifies this species with M. laeta Meig., taking the latter as a synonym for M. variegata Meig. For all that, these species differ very much from one another. To begin with, in M. laeta there is a stripe on the scutellum, noticed by Meigen, which is absent in M. variegata; in its place there is sometimes only a light narrow line, noticed by Tsetterstedt. Besides that, the palps in M. variegata, as distinct from M. laeta, are light, as was observed by Schiner. It is only in isolated individuals that the extreme tip of the palps is brown. The hind femora in M. variegata are stouter than those in M. laeta. Lastly, the differences in the structure of the hypopygium

••The author has had no chance of becoming acquainted with the types of these species; that is why the synonomy, to a certain degree, should be taken as provisional.

of the male (Figs. 2 and 7) confirm the independence of both species. The ecological features of the species also lend support to their independence; the association of M. variegata with meadows (already remarked on by Meigen) and the absence from meadows of M. laeta.

For no reason, Duda assumes M. variegata to be a variety of M. saltatrix. As is evident from our identification tables, these species differ from one another in all the essential characters.

This species is met with in meadows, preferably in mown meadows. It flies from the middle of July to the end of August. Frequently seen. The larvae develop in the stems of meadow foxtail grass (Alopecurus pratensis L.), couch grass (Agropyrum repens L.) and meadow fescue (Festuca pratensis Huds.).

Occurrence: Ukraine, Moscow region.

M. laeta Meigen, 1838.

Schiner, 1864.—variegata Becker, 1905 (nec.Meigen).

It is necessary to re-establish this species which was assumed by Becker to be a synonym for M. variegata, as was mentioned above. We adopt M. laeta from Meigen and Schiner.

It is a very common species. In contrast to M. variegata, it is almost never found in meadows but, on the other hand, frequents dry, very warm districts on sunny verges. It flies from the end of June to the middle of August. It develops in the stems of the common bent grass (Agrostis vulgaris With.) and red fescue (Festuca rubra L.).

Occurrence: Ukraine, Krasnodarsk region, regions of Moscow, Kemerova, Kustanay and Chelyabinsk.

M. mosquensis Fed. One of the very common species in Chasnik. It is absent from dry meadows but prefers dry, sunny fields and slopes with poor or mown grass. It flies from the end of June to the middle of August. It develops in Festuca rubra L.

Occurrence: Moscow and Leningrad regions.

M. femorata Macquart, 1835.

Meigen, 1835; Schiner, 1864.—saltatrix var. variegata subvar. typica Duda, 1933.

This species has not been met with in Chasnik. It was found in large numbers in the Moscow river valley near Zvenigorod at the end of July. It is related to M. variegata, but differs from it in the black color of the palps, the bright red, or very often, yellow color of the stripes on the mesonotum, the middle one of which is more or less continued on to the scutellum, and also the stouter hind femora. The anterior parameres of the male M. femorata have stout teeth at the end, each on a triangular base, but in M. variegata the ends are flat and the teeth levelled off (Figs. 2 and 5).

M. nigriseta Fed. An account of the systematic position is given in the description. The species is fairly scarce. One meets it principally along the sides of roads and hedges. It flies from the middle of June to the middle of August.

Occurrence: Ukraine, Krasnodarsk region, regions of Moscow, Leningrad, Stalingrad, Kemerov, Akmolinsk, Kustanay and Pavlodar.

M. triangulina Fed. It is easily recognized by the black hairs on the gena and the sharply bordered frontal triangle.

The species is fairly common. It is met with in swamped meadows and on river banks. It flies from the middle of June to the middle of August. The larvae are found in the stems of sheep's fescue (Festuca ovina L).

Occurrence: Moscow and Leningrad regions.

M. palposa Fed. This species is very scarce. Up to now the male is unknown. Having only a small quantity of material at our disposal we could not fix the limits of variation of the majority of characters. Above all, one can consider as reliable characters the widened and flattened palps, the thin, hind femora and, to all intents and purposes, the shape of the parameres of the hypopygium (Fig. 12).

The meromyzid fauna of the Moscow region (previously a province) was studied by A. P. Fedchenko. His list of species from Moscow (1868) contains four species of Meromyza:—M. pratorum Meig., M. saltatrix L., M. variegata Meig., and M. nigriventris Macq. In the collection of A. P. Fedchenko, which is preserved in the Zoological Museum of Moscow University five species of the genus are included,—to the species enumerated are added two specimens labelled M. femorata Macq.

Having checked the determinations of A. P. Fedchenko,†† I came to the following conclusions:

1) M. pratorum Meig.—is an accurately determined species.

2) M. saltatrix L.—is labelled as three species: M. saltatrix L., M. triangulina Fed., and M. femorata Macq.

3) M. variegata Meig.—proved to be M. mosquensis Fed.

4) M. nigriventris Macq.—M. triangulina Fed. and M. saltatrix (dark specimens) are included here; two specimens proved to be M. mosquensis Fed.

5) M. femorata Macq.—in reality it proved to be M. variegata Meig.

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†† For permission to look through this collection I thank A. N. Zhelokhovtsev and L. V. Ziminoi.

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M. Macquart, Suites à Buffon, II (Meromyza: 589–592) (1835) pp. 1–666.

J. Meigen, Systematische Beschreibung der zweiflügeligen Insekten, VI, 1–404 (Meromyza: 163–165) (1830); VII (Meromyza: 395–396) (1838) pp. 1–434.

R. Schiner, Die Fliegen (Diptera), Fauna Austriaca, II (Meromyza: 209–210) (1864) pp. 1–656.

J. Zetterstedt, Diptera Scandinaviae, VII (Meromyza: 2585–2593) (1848) pp. 2581–2944.

# THE TROMBICULID MITES OF THE GENUS GAHRLIEPIA (ACARIFORMES, TROMBICULIDAE) FROM NORTH VIETNAM

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About 3000 larvae of trombiculid mites, belonging to the subfamily Gahrlieptinae Womersley, 1952, were collected from mammals in North Vietnam. This material is represented by 9 species: Gahrliepia (Walchia) chinensis Chen Hsin-tao and Hsu Ping-kuen, 1955, G. (W.) micropelta Traub and Evans, 1957, G. (W.) rustica (Gater, 1932), G. (W.) disparunguis (Oudemans, 1929), G. (W.) pacifica Chen Hsin-tao and Hsu Ping-kuen, 1955, G. (W.) dismina, sp. n., G. (W.) delicatula, sp. n., G. (Gahrliepia) mirabilis, sp. n. and G. (G.) tenella Traub and Morrob, 1955.

G. (W.) chinensis and G. (W.) rustica were found to be the most common and the most widely distributed species. The former was often found on rats and mice captured in or near human habitations, in shrub and grass patches. In Hanoi G. (W.) chinensis was most numerous on the rat Rattus norvegicus Berkenhout.

The larvae of G. (W.) rustica were found on rodents captured in different types of forests: much thinned out by felling, weakly shaded (Vin'-Lin', Tai-Nguen), as well as in typically tropical forests, humid and swampy (Fu-Kui). The less frequently found species, G. (W.) disparunguis, is similar to the former in its distribution. G. (W.) pacifica were collected only from the rodent Rhizomys pruinosus Blyth. in the Khazhan province, and nowhere else.

The rest of the species were collected only in small numbers in the areas examined.

This work is divided between the authors in the following way: I. M. Grokhovskaya, Tang Wang-ngu, Nguen Song-hoe and To King-tung collected the material; I. M. Grokhovskaya wrote the introduction and E.G. Shluger identified and described the mites.

## Gahrliepia (Walchia) chinensis Chen Hsin-tao and Hsu Ping-kuen, 1955. (Figs. 1 - 8).

Chen Hsin-tao and Hsu Ping-kuen, 1955, Acta Zool. Sinica, 7,2: 114–115.

Small mites. In starved and incompletely gorged larvae the body is oval, gradually narrowing toward the posterior end, with distinctly protruding or rounded shoulders; in engorged larvae the body is elongate, the lateral edges being almost parallel in the posterior half. The cephalic scutum is small and narrow, pentagonal in shape (it is 1.4–1.6 times longer than it is wide at the level of bases of posterior setae). Anterior border of the scutum is straight or concave, the posterior border is bluntly angular; lateral borders are either straight or slightly convex, parallel to each other, or slightly diverging posteriorly. The surface of the scutum is covered with very fine, not always distinct, stippling. The anterior and the posterior setae are located in the corners of the scutum; they are short, roughly equal in length and are covered with long, sparse hairs. The trichobothrial "club" is spherical. Bothridia are located near the lateral borders of the scutum, at an equal distance from the bases of anterior and posterior setae. There are thin, crescent-shaped combs above the bothridia. Eyes single, very weakly developed, can be seen only in starved and incompletely engorged larvae. There are 2 shoulder setae, one on each side, 30–35 dorsal setae, disposed in transverse rows with the following numbers of setae in each row: 6–6–2–6–4–4–2–2, and 45–52 ventral setae.

Legs are short. Legs in 1st pair (without coxae) are 0.12–0.127 mm long, those in 2nd pair 0.09–0.1 mm and in 3rd pair 0.125–0.13 mm. Tarsi of the 3rd pair of legs are 4–4.5 times as long as they are broad at the greatest width. Two solenidien on the 1st tibiae (one at the base, the other in the middle). Two setae on the 3rd coxae, one of them almost in the middle of the anterior border, the other near the internal surface. Hypostomal setae are smooth. Setae on the palpal femora, tibiae and tarsi are smooth.

Body length of larvae is 0.163–0.392 mm and width is 0.104–0.259 mm.

Length of setae (in mm): anterior 0.02–0.23 (average 0.021), posterior 0.023–0.026 (average 0.025), dorsal 0.021–0.034 (average 0.026) and ventral 0.013–0.025 (average 0.018).

Systematic notes. Gahrliepia (Walchia) chinensis, found in North Vietnam, is quite identical to that described from China. There are some insignificant differences between them in the length of setae of the body and scutum.

Distribution and hosts. In China it is found on the rat, Rattus norvegicus Berkenhout. In North Vietnam it is

Figs. 1–8. Gahrliepia (Walchia) chinensis Chen Hsin-tao et Hsu Ping-kuen. 1) Larva from above. 2) Larva from below. 3) Cephalic scutum. 4) Palp from the side. 5) First tibia from above. 6) Third metatarsus and tarsus from the side. 7) Dorsal seta. 8) Ventral seta.

common in Hanoi, but relatively rare in other localities (Fu-Kui, Lao-Gai, Khazhan and Khalam). Parasitizes mice, Mus musculus bactranus Blyth., M. m. urbanus Hodgson; rats, Rattus norvegicus, R. rattus tikos Hinton, R. nitidus nitidus Hodgson; primates, Tupaia ferruginea Raffles.

## Gahrliepia (Walchia) micropelta Traub and Evans, 1957. (Figs. 9 – 16).

Traub and Evans, 1957, Stud. Inst. med. Res. Malaya, 28 : 311–313.

Very small mites. Body oval or elongate in incompletely gorged and gorged larvae, with large, strongly protruding shoulders and straight parallel sides in the posterior half. Cephalic scutum very small, narrow, pentagonal in shape (1.5–1.8 times longer than it is wide at the level of bases of posterior setae). Its anterior border is concave, the posterior one is wide-angled; lateral borders straight, or somewhat convex, parallel to each other. Stippling on the scutum is indistinct. Anterior and posterior setae in the angles of the scutum, very short, of equal length, or the posterior ones somewhat longer than the anterior ones. The trichobothrial "club" is spherical, covered with relatively long hairs. Bothridia on lateral edges of the scutum, at approximately equal distance between the bases of the anterior and the posterior setae. Thin, crescent-shaped combs above each bothridium. Eyes very small, single (indistinct even in starved larvae). One shoulder seta on each side. Not fewer than 30–34 dorsal setae; these are distributed in transverse rows with the following number of setae in each row: 6–6–6–6–6–2–2. Dorsal setae short, covered with long fine hairs. 46–49 abdominal setae.

Legs very short: length of legs in 1st pair (without coxae) is 0.099–0.104 mm, in 2nd pair 0.075–0.08 mm and in 3rd pair 0.1–0.108 mm. Tarsus of 3rd pair of legs is short, only 2.1–2.4 times as long as it is broadest. Two solenidien on the 1st tibiae (one near the base, the other in the middle). Two closely placed setae on the 3rd coxae, at the same level with each other, near the internal border. Hypostomal setae smooth, short. All the setae on the palps, except the tarsal ones are small and smooth.

Length of body of larvae is 0.163—0.355 mm, maximum width is 0.108—0.259 mm.

Length of setae (in mm): anterior 0.013—0.015 (average 0.014), posterior 0.016—0.019 (average 0.018), dorsal 0.015—0.024 (average 0.021) and ventral 0.01—0.023 (average 0.015).

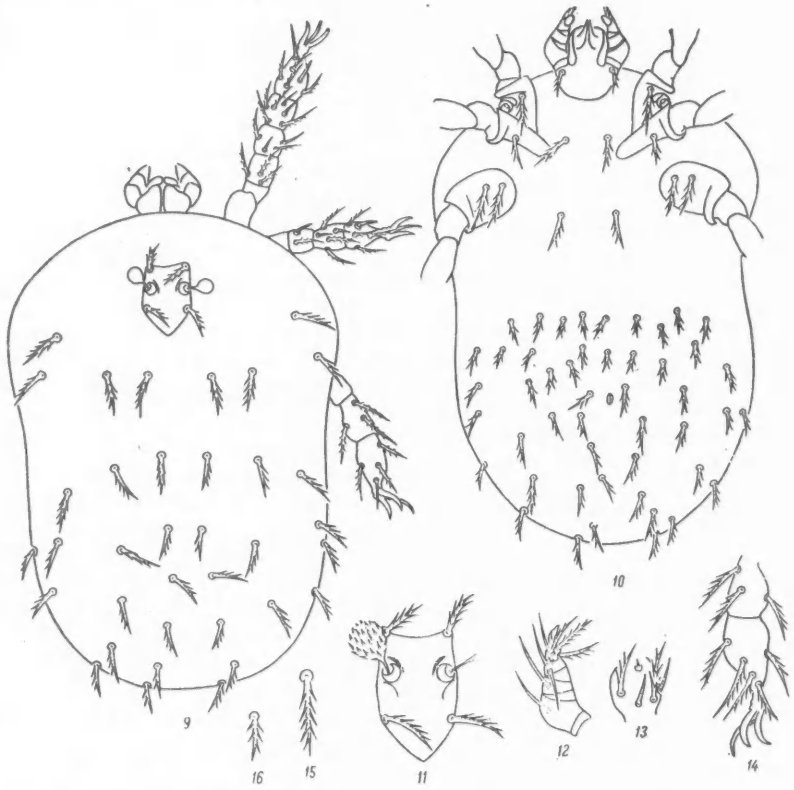
Systematic notes. This species is similar to Gahrliepia (Walchia) chinensis, from which it is distinguished by the smaller size of body and scutum, and also by a different distribution of setae on the 3rd coxae.

Distribution and hosts. This species was described from Thailand (Traub and Evans, 1957) from Mus sp. and Rattus sp. In North Vietnam (Fu-Kui, Lao-Gai and Tin-Tuk) found on the rat Rattus nitidus nitidus.

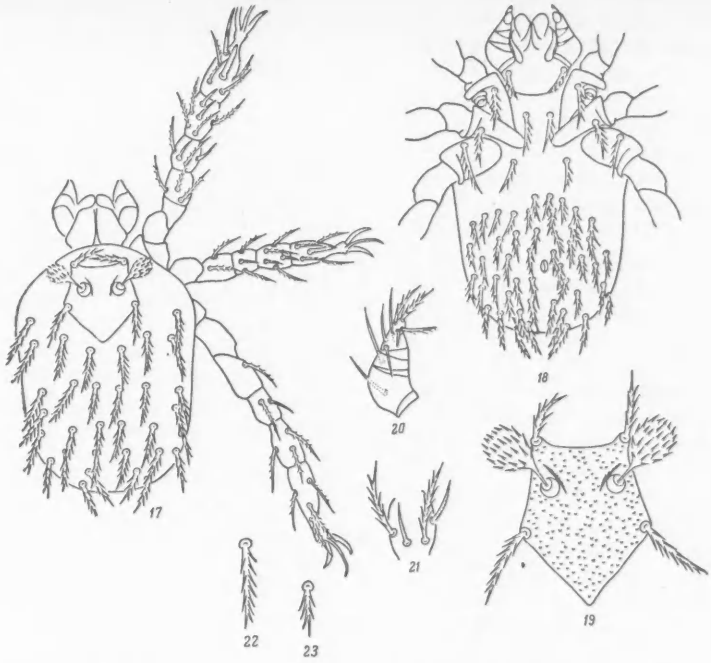
Gahrliepia (Walchia) rustica (Gater, 1932). (Figs. 17 – 23).

Gater, 1932, Parasitol., 24 : 167—168 (Gahrliepia rustica); Radford, 1942, Parasitol., 34, 1 : 64; Womersley and Heaslip, 1943, Trans. Roy. Soc. S. Aust., 67, 1 : 136 (Walchia rustica); Sig Thor und Willmann, 1947, Das Tierreich, 71b : 337; Fuller, 1948, Bull. Brooklyn Entom. Soc., 43, 4 : 110; Fuller, 1949, Proc. Biol. Soc. Wash., 62 : 1—2; Wharton and Fuller, 1952, Mem. Entom. Soc. Wash., 4: 93; Gunther, 1952, Proc. Linn. Soc. New South Wales, 77, 1—2 : 45; Fuller, 1952, Zool. Verhand. 18 : 205; Womersley, 1952, Rec. S. Aust. Mus., 10, 1—2 : 286—287 [Gahrliepia (Walchia) rustica]; Radford, 1954, Parasitol., 44, 3—4 : 270 (Walchia rustica); Traub and Evans, 1957, Stud. Inst. med. Res. Malaya, 28 : 339—342 [Gahrliepia (Walchia) rustica].

In starved and incompletely gorged larvae the body is oval with distinctly protruding or completely rounded shoulders; in fully gorged ones the body is elongate-oval. Cephalic scutum of medium size, pentagonal in shape (1.1—1.3 times longer than broad at the level of bases of posterior setae), with anterior angles lengthened into short cylindrical protrusions. Anterior border of scutum straight or with a shallow indentation, the posterior border wide-angled, lateral borders straight, strongly diverging posteriorly. The entire surface of scutum covered with a fine, but distinct stippling. Anterior and posterior setae in the angles of the scutum, short, of about equal length. Trichobothrial




Figs. 9—16. Gahrliepia (Walchia) micropeta Traub and Evans. 9) Larva from above. 10) Larva from below. 11) Cephalic scutum. 12) Palp from the side. 13) First tibia from above. 14) Third metatarsus and tarsus from the side. 15) Dorsal seta. 16) Ventral seta.




Figs. 17–23. Gahrliepia (Walchia) rustica (Gater). 17) Larva from above. 18) Larva from below. 19) Cephalic scutum. 20) Palp from above. 21) First tibia from above. 22) Dorsal seta. 23) Ventral seta.

"club" quite large, elongate-oval in shape, covered with long hairs. Bothridia near the lateral borders of scutum, at an equal distance between the origins of anterior and posterior setae. Crescent-shaped combs above the bothridia. Eyes small, appear to be single, located on sides of the body at the same level as the bothridia. Two shoulder setae, 30–38 dorsal ones (grouped in transverse rows with 6–6–2–6–6–4–2–2 setae in each row), and 47-61 ventral ones. Dorsal setae are short; their length gradually decreases from the front backwards; they are covered with long, fine hairs. Legs of average size; 1st legs (without coxae) are 0.148–0.163 mm long, 2nd pair 0.118–0.126 mm and 3rd pair 0.148–0.163 mm long. Length of 3rd tarsus is 3.6–4.5 times as great as its maximum diameter. Two solenidien on the 1st tibiae, one in the middle, the other at the base. The seta on the 3rd coxa is on the anterior border, near the external surface. All the setae smooth on the palpal femur, tibia and tarsi. In the type specimen of G. (W.) rustica, according to Gater (1932), the seta on the palpal tibia is smooth or has 1–2 hairs. Hypostomal setae are smooth and fine.

Length of body of larvae 0.141–0.340 mm, with a maximum width of 0.089–0.237 mm.

Length of setae (in mm): anterior 0.025–0.029 (average 0.026), posterior 0.025–0.033 (average 0.028), dorsal 0.018–0.035 (average 0.029) and ventral 0.015–0.03 (average 0.021).

Systematic notes. Similar to Gahrliepia (Walchia) turmalis (Gater, 1932), but distinguished from it by the smaller number of setae on the body and by a wider scutum.

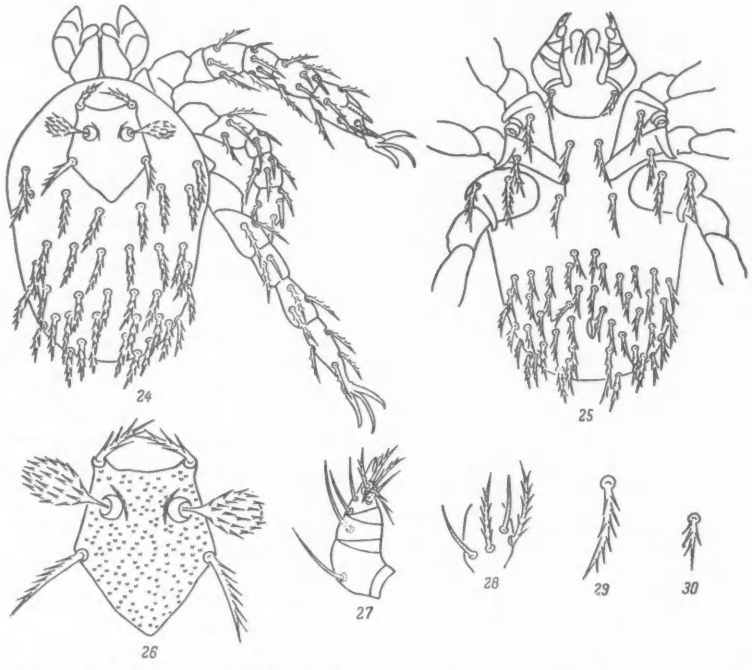
Distribution and hosts. Parasitzes rats (Rattus rattus jalorensis Bonhote, R. rajan surifer Miller, R. r. sladeni Anderson, R. r. yunnanensis Anderson, R. mülleri Jentink, R. sabanus Thomas, R. nitidus nitidus Hodson); squirrels (Callosciurus notatus Boddaert, Cannomys badius monir Gray, Menetes berdmorei Blyth); bandicotes (Bandicota bengalensis Gray and Hardwicke); insectivores (Crocidura sp., Suncus caeruleus fulvocinereus Anderson); bird (Cyanops lineatus hodgsoni Bonaparte). Widely distributed in the Malay Federation, Burma, Assam and Thailand. In North Vietnam (Fu-Kui, Kamfa, Lao-Gai, Hazhan, Tin-Tuk, Vin'-Lin' and Tai-Nguen) found on rats (Rattus rattus khyensis Hinton, R. r. tikos Hinton, R. r. flavipectus Milne–Edwards, R. exulans concolor Blyth, R. R. grochovskii D. Tien, in litt., R. nitidus nitidus) and on primates (Tupaia hongoensis).

Garhliepia (Walchia) disparunguis (Oudemans, 1929). (Figs. 24 – 30).

Oudemans, 1929, Entom. Ber., 7 (165): 398–399 (Schöngatiella disparunguis); Womersley, 1944, Trans. Roy. Soc. S. Aust., 68, 1: 83, 101–102 (Walchia disparunguis); Kohls, Armbrust and Philip, Amer. Journ.Hyg., 41, 3: 381; Oudemans, 1945, Buitendijk, Zool. Meded., 24: 336 (Schöngastia disparunguis); Mohr, 1947, Ecology, 28, 2: 194–199 (Walchia disparunguis); Sig Thor und Willmann, 1947, Das Tierreich, 71b: 335 (Schöngastiella disparunguis); Womersley, 1952, Rec. S. Aust. Mus., 10, 1: 290–291 [Gahrliepia (Walchia) disparunguis]; Fuller, 1952, Zool. Verhand., 18: 207–210 (Walchia disparunguis); Gunther, 1952, Proc. Linn. Soc. N. S. W., 77, 1–2: 44; Wharton and Fuller, Mem. Entom. Soc. Wash., 4: 92; Radford, 1954, Parasitol., 44, 3–4: 270; Traub and Evans, 1957, Stud. Inst. med. Res. Malaya, 28: 327–331 [Gahrliepia (Walchia) disparunguis disparunguis].

In starved or incompletely gorged larvae the body is oval or elongate-oval, narrowed in the posterior half, with completely smooth or protruding shoulders; in fully gorged larvae the body is elongate, with almost parallel sides behind the 3rd coxae. Cephalic scutum of medium size, pentagonal in shape (its length is equal to its width or somewhat greater), with the anterior angles elongated into short cylindrical protrusions. Its anterior border is straight or concave, the posterior border is wide-angled, lateral borders straight, diverging posteriorly. The entire scutum uniformly covered with well discernible stippling. Setae on the scutum are short, of approximately equal length; the anterior ones are placed at the apices of protrusions, the posterior ones in the corners. Trichobothrial "club" is large, pear-shaped, covered with long hairs. Bothridia near the lateral borders of the scutum, at an equal distance from the bases of the anterior and the posterior setae. Thin, crescent-shaped combs above the bothridia. Eyes small, appear to be single, visible in starved and incompletely gorged larvae. Two shoulder setae, 35–38 dorsal setae (in transverse rows with the following number of setae in each row: 6–6–6–6–4(6)–4–2–2), and 46–60 ventral setae. Dorsal setae short, with fine, long hairs. Legs of medium size: 1st pair (without coxae), 0.155 mm, 2nd pair 0.118 mm and 3rd pair 0.155–0.170 mm. The length of the tarsus of the 3rd pair of legs exceeds its maximum width 3.6–4 times. On the tibiae of the 1st pair of legs there is one solenidien at the base and another one in the middle. Two setae on the 3rd coxae; of these one is on the anterior border, near the external surface, and the other one at a considerable distance from it, nearer to the internal surface. Hypostomal setae smooth. Setae on palpal femora, tibiae and tarsi smooth.

Body length 0.148–0.296 mm, width 0.111–0.155 mm. Length of setae (in mm): anterior 0.023–0.026 (av-




Figs. 24–30. Gahrliepia (Walchia) disparunguis (Oudemans). 24) Larva from above. 25) Larva from below. 26) Cephalic scutum. 27) Palp from the side. 28) First tibia from above. 29) Dorsal seta. 30) Ventral seta.

erage 0.024), posterior 0.025—0.029 (average 0.027), dorsal 0.02—0.03 (average 0.027), and ventral 0.016—0.028 (average 0.02).

Systematic notes. Related to G. (W.) cwingi Fuller, 1949, from which it is distinguished by the presence of 2 setae on the 3rd coxae.

Distribution and hosts. Parasitizes Millarda meltada Gray, rat Rattus rattus kandianus Kelaart, bandicote Bandicota bengalensis Gray and Hardwicke. Distributed throughout Ceylon, Borneo, Celebes, Southern Burma, New Guinea and Western Java. In North Vietnam (Fu-Kui, Vin'-Lin'), found on rats Rattus vinhlinh D. Tien, in litt., R. r. wroughteni Hinton, R. r. khyensis Hinton and R. r. tikos.

Gahrliepia (Walchia) dismina Schluger, Grochovskaja, Tang Wang-ngu, Nguen Song-hoe and To King-tung, sp. n. (Figs. 31 — 38).

Relatively a large species. In incompletely gorged and completely gorged larvae the body is elongate, with strongly protruding shoulders and with straight or somewhat convex lateral sides in the posterior half. Cephalic scutum of medium size (1.2—1.4 times longer than it is wide at the level of bases of posterior setae), pentagonal in shape, with the anterior angles elongated into short cylindrical protrusions. Anterior border of the scutum is either straight or concave, the posterior border is wide-angled, lateral borders straight, sometimes slightly concave, either somewhat diverging posteriorly or parallel to each other. The entire surface of the scutum covered with a fine, but distinct stippling. Posterior setae, noticeably longer than the anterior ones, are placed in the corners of the scutum, the anterior ones on the protrusions. Trichobothrial "club" in the shape of an elongate oval, covered with long hairs. Bothridia near the lateral borders of the scutum, approximately at an equal distance between the bases of the anterior and the posterior setae. Crescent-shaped combs above the bothridia. Eyes, apparently, absent. Two shoulder setae, 34—40 dorsal ones (in transverse rows with 6—6—6—6—4—2—4—2 setae in respective rows), 45—51 ventral setae. Legs relatively thin and long: the length of the 1st pair (without coxae) is 0.207 mm, 2nd pair 0.163—0.178, 3rd pair 0.207—0.222 mm. Length of tarsus of the 3rd pair of legs exceeds its maximum width not less than 6.4—7.5 times. Two thin, needle-like solenidien on the 1st tibiae, one at the base, the other in the middle portion. On each coxa of the 3rd pair of legs there are two setae; one of them is on the anterior border near the external surface, the other one at some distance from the middle of the anterior border. Hypostomal setae smooth, thin. All the setae on the palps (except the tarsi) are smooth; a long seta on the palpal tibia, short ones on the palpal femur and tarsus.

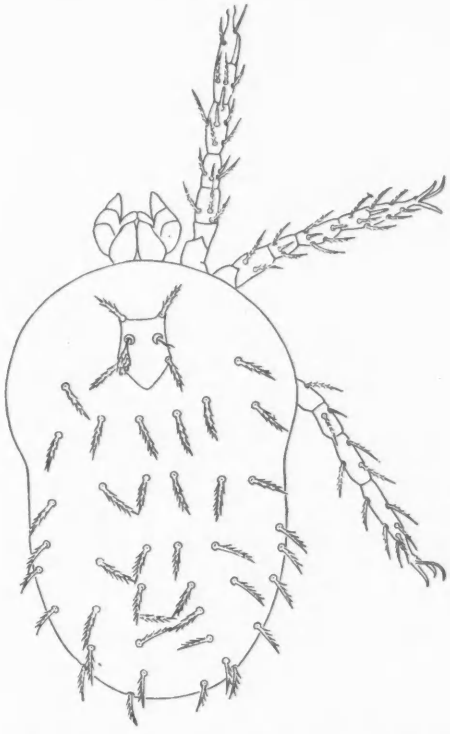


Fig. 31. Gahrliepia (Walchia) dismina Schluger, Grochovskaja, Tang Wang-ngu, Nguen Song-hoe and To King-tung, sp. n. Larva from above.

Body length of the larvae 0.303—0.533 mm, with a maximum width of 0.2—0.355 mm.

Length of setae (in mm): anterior 0.019—0.024 (average 0.022), posterior 0.028—0.03 (average 0.029), dorsal 0.025—0.038 (average 0.032) and ventral 0.018—0.033 (average 0.023).

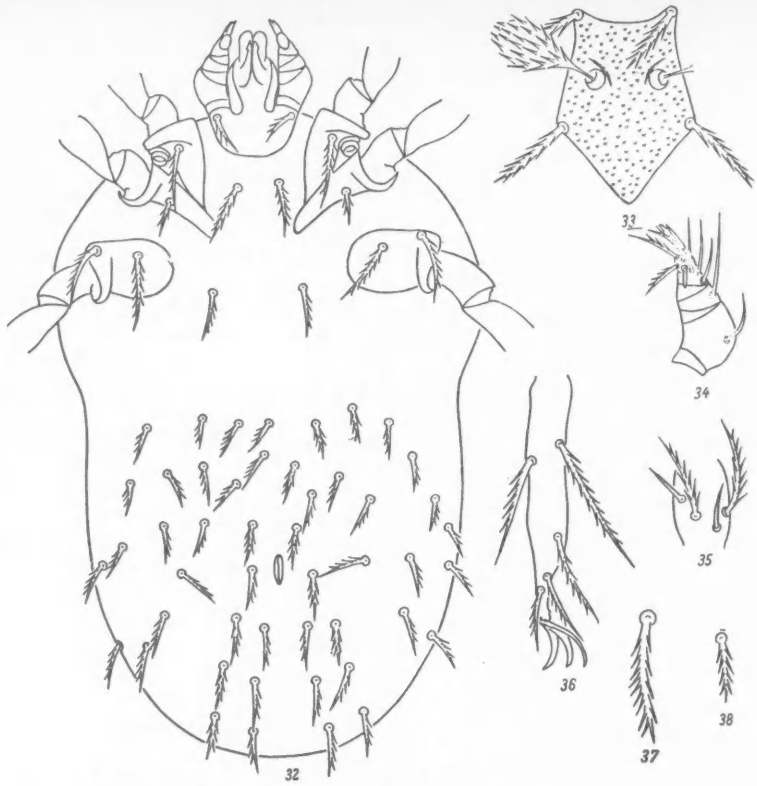
Systematic notes. According to the shape of the scutum it resembles Gahrliepia (Walchia) kritochaeta Traub and Evans, 1957, from which it is distinguished by the presence on the 3rd coxae of two setae (instead of one), and by longer legs.

Distribution and hosts. Found in North Vietnam (Fu-Kui) on a rat, Rattus sp.

Gahrliepia (Walchia) pacifica Chen Hsin-tao and Hsu Ping-kuen, 1955. (Figs. 39 — 45).

Chen Hsin-tao and Hsu Ping-kuen, 1955, Acta Zool. Sinica, 7 (2): 112—114.

Medium-sized mites. In incompletely gorged larvae the body is oval or elongate-oval, narrowed in the posterior half, with protruding or completely smooth shoulders. Cephalic scutum of medium size, pentagonal in shape, 1.4—1.6 times longer than it is wide at the level of bases of posterior setae. Its anterior border is either straight or slightly concave, lateral borders between the bases of the anterior and the posterior setae convex or




Figs. 32–38. Gahrliepia (Walchia) dismina Schluger, Grochovskaja, Tang Wang-ngu, Nguen Song-hoe and To King-tung sp. n. 32) Larva from below. 33) Cephalic scutum. 34) Palp from the side. 35) First tibia from above. 36) Third tarsus from the side. 37) Dorsal seta. 38) Ventral seta.

straight, almost parallel to each other, behind the bases of the posterior setae gradually converge to a sharp or a rounded posterior end. Anterior and posterior setae in the corners of the scutum, short, of equal length, or the posterior ones somewhat longer than the anterior. Trichobothrial "club" in the shape of a much elongate oval, covered with long hairs. Bothridia near the lateral borders of the scutum, at an equal distance between the bases of the anterior and the posterior setae. Thin crescent-shaped combs above the bothridia. Two shoulder setae on each side, 2 sub-scapular ones, seldom 3. 34–36 dorsal setae (in transverse rows with 8–6–2–6–4–4–2–2 setae in respective rows) and 38–43 ventral setae. Dorsal setae short, with relatively small hairs. Medium sized legs: 1st pair (without coxae) 0.148–0.163 mm, 2nd pair 0.118–0.133 mm and 3rd pair 0.163–0.178 mm. Tarsus of 3rd pair of legs 3.5–4.1 times longer than it is at its widest. Two solenidien on the 1st tibiae, in the middle portion, both at almost the same level. The seta on the 3rd coxae is placed at a considerable distance from the anterior border, nearer to the internal than to the external surface. Hypostomal setae long, smooth. Setae are smooth and short on all the palpal segments, except the palpal tarsi.

Body length 0.244–0.414 mm, width 0.178–0.281 mm. Length of setae (in mm): anterior 0.03–0.035 (average 0.032), posterior 0.033–0.038 (average 0.036), dorsal 0.026–0.038 (average 0.034) and ventral 0.018–0.036 (average 0.024).

Distribution and hosts. Originally described from China from the rat Rattus norvegicus. In North Vietnam (Hazhan) found on Rhizomys pruinosus Blyth. (Spalacidae).

Gahrliepia (Walchia) delicatula Schluger, Grochovskaja, Tang Wang-ngu, Nguen Song-hoe and To King-tung, sp. n. (Figs. 46–53).

Medium-sized mites. In young larvae the body is egg-shaped with much rounded shoulders; in incompletely and completely gorged ones the body is elongate, either narrowed or with parallel sides in the posterior half.

Cephalic scutum relatively large, pentagonal in shape, 1.3—1.5 times longer than it is wide at the level of bases of posterior setae. Its anterior border is concave, lateral borders between the bases of the anterior and the posterior setae either straight or weakly convex, diverging posteriorly, and behind the bases of posterior setae narrowing down sharply toward a pointed posterior end. The entire surface of the scutum covered with a fine, but distinct stippling. The anterior and the posterior setae are located in the corners of the scutum; they are short, roughly equal in length. Trichobothrial "club" in the shape of an elongate oval, covered with fine long hairs. Bothridia not far from the lateral borders of the scutum, at an equal distance between the bases of the anterior and the posterior setae. Thin, crescent-shaped combs above the bothridia. Eyes double, of medium size (well seen in starved and incompletely gorged larvae). Two scapular setae (one on each side), 34—36 dorsal setae, in transverse rows of 6—6—6(8)—6—4—2—4 setae, and 40—44 ventral setae. The dorsal setae are short, covered with medium-sized hairs. Legs moderately long; first pair (without coxae) is 0.163—0.170 mm, second pair 0.133—0.141 mm and third pair 0.163—0.178 mm in length. The 3rd tarsus is 3.4—4 times longer than it is at its widest. Two solenidien on the tibiae of the 1st pair of legs; they are located in the middle portion at about the same level with each other. The seta on the 3rd coxae is placed at a considerable distance from the middle of the anterior border. Hypostomal setae long, fine, smooth. All the setae on the palps, except the palpal tarsi, are smooth, fine, short.

Body length of larvae 0.170—0.370 mm with a maximum width of 0.141—0.252 mm.

Length of setae (in mm): anterior 0.031—0.036 (average 0.034), posterior 0.03—0.035 (average 0.034), dorsal 0.023—0.038 (average 0.031) and ventral 0.016—0.035 (average 0.024).

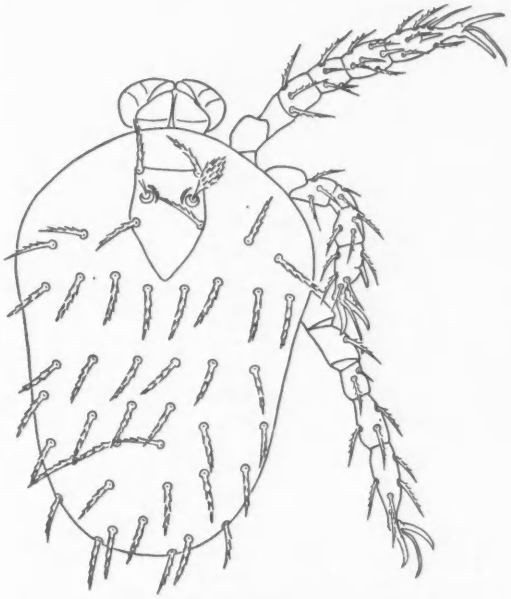
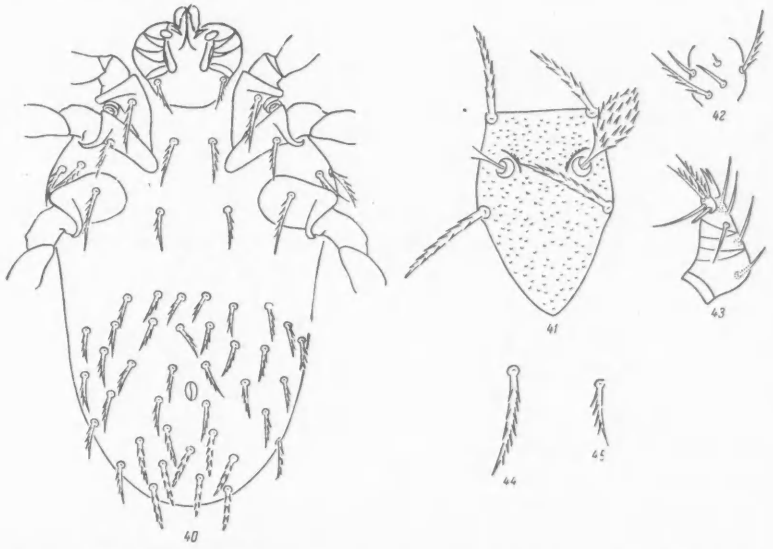
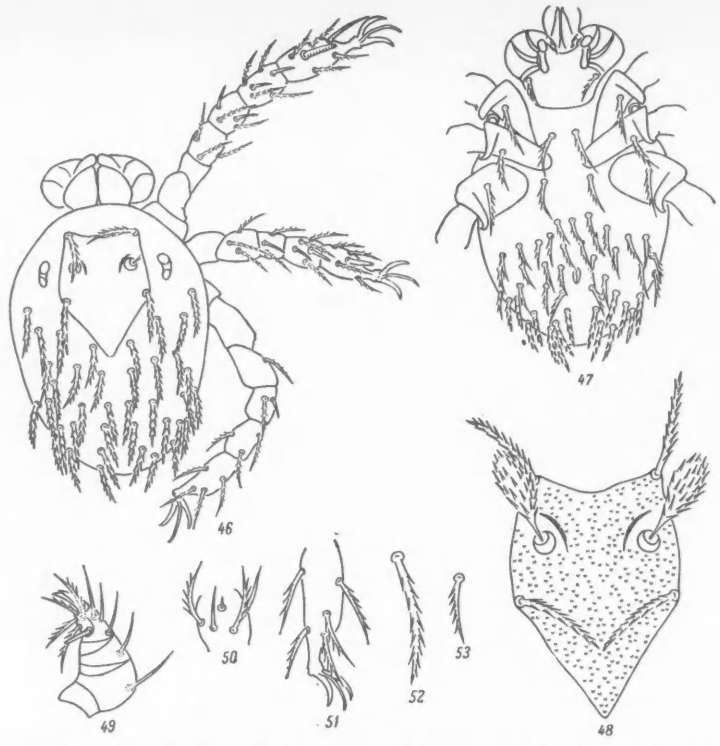


Fig. 39. Gahrliepia (Walchia) pacifica Chen Hsin-tao and Hsu Ping-kuen. Larva from above.




Figs. 40—45. Gahrliepia (Walchia) pacifica Chen Hsin-tao and Hsu Ping-kuen. 40) Larva from below. 41) Cephalic scutum. 42) First tibia from above. 43) Palp from the side. 44) Dorsal seta. 45) Ventral seta.




Figs. 46–53. Gahrliepia (Walchia) delicatula Schluger, Grochovskaja, Tang Wang-ngu, Nguen Song-hoe and To King-tung, sp. n. 46) Larva from above. 47) Larva from below. 48) Cephalic scutum. 49) Palp from the side. 50) First tibia from above. 51) Third tarsus from the side. 52) Dorsal seta. 53) Ventral seta.

Systematic notes. Resembles very much the species described from China, Gahrliepia (Walchia) neosinensis Hsu Jin-chi and Wen T'in-whan, 1956, from which it is distinguished by the shape of the trichobothria, the location of the seta on the 3rd coxae, the smooth external lateral seta on the palpal tarsi, a broader scutum and other characteristics.

Distribution and hosts. In North Vietnam (Khazhan, Kamfa) found on Rhizomys pruinosus, Tupaia hongaensis and Rattus norvegicus.

Gahrliepia (in sp.) mirabilis Schliger, Grochovskaja, Tang Wang-ngu, Nguen Song-hoe and To King-tung, sp. n. (Figs. 54-60).

In starved and incompletely gorged larvae the body is oval, somewhat narrowed in the anterior half, with parallel sides in the posterior half; shoulders either weakly defined or completely rounded. Cephalic scutum large, almost hexagonal in shape, 1.3–1.4 times longer than its greatest width. Its anterior border very weakly concave, posterior border straight, lateral borders in the anterior half slightly convex or straight and diverging posteriorly,

Fig. 54. Gahrliepia (in sp.) mirabilis Schluger, Grochovskaja, Tang Wang-ngu, Nguen Song-hoe and To King-tung, sp. n. Larva from above.

in the posterior half weakly concave, gradually narrowing toward the posterior end. The entire surface of the scutum covered with a fine stippling. Four pairs of setae on the scutum (not counting the trichobothria); of these the anterior pair is in the corners of the scutum, the posterior pair on the lateral sides, the first accessory pair behind the posterior pair, at a considerable distance from the lateral borders, the second accessory pair near the posterior corners. All the setae on the scutum are short, of approximately equal length. Trichobothria flask-shaped, covered with fine, long hairs. Bothridia near the lateral sides of the scutum, roughly at an equal distance between the bases of the anterior and the posterior setae. Thin, crescent-shaped combs above the bothridia. Eyes weakly developed, appear to be double, are placed on the sides at the same level as the bothridia. Two scapular setae (one on each side), 32–34 dorsal in transverse rows of 4–6–6(8)–6–4–2–4 setae in each row, and 45–48 ventral setae. Dorsal setae are short, with coarse, moderately long hairs.

Medium-sized legs: 1st pair (without coxae) are 0.17–0.185 mm, 2nd pair 0.133-0.148 mm and 3rd pair 0.17–0.185 mm in length. The 3rd tarsus is 3.3–3.5 times longer than it is at its widest. Two thin needle-like solenidien on the 1st tibiae, in the middle portion, at almost the same level with each other. The seta on the 3rd coxa is placed at some distance from the anterior border, usually somewhat nearer to the external than to the internal side. Hypostomal setae smooth and long. On the palpal femur the seta is with small sparse hairs, which may be well seen under the microscope with oil immersion; on the palpal tibia and tarsus all the setae are smooth.

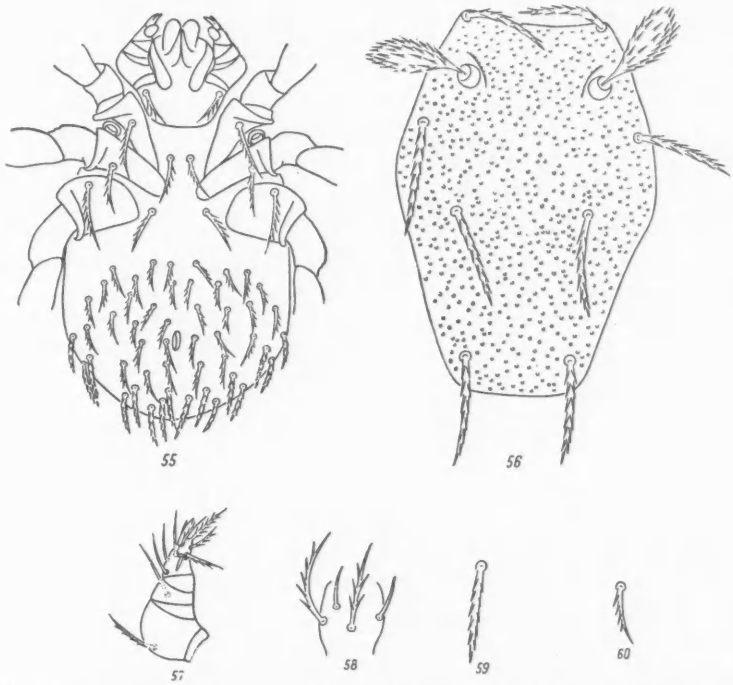
The length of the body is 0.207–0.287 mm with a maximum width of 0.155–0.163 mm.

Length of setae (in mm): anterior 0.03–0.036 (average 0.033), posterior 0.033–0.038 (average 0.036), dorsal 0.025–0.039 (average 0.031) and ventral 0.019–0.034 (average 0.022).

Systematic notes. Resembles very much Gahrliepia (in sp.) jangchenensis Chen Hsin-tao and Hsu Ping-kuen, 1957, from which it is distinguished by the smooth setae on the palpal tibiae and tarsi and by other characteristics.

Distribution and hosts. In North Vietnam (Kamfa, Khazhan, Khalam, Fu-Kui, Vin'-Lin') found on Rhizomys pruinosus and on rats Rattus rattus khyensis and R. edwardsi.

Gahrliepia (in sp.) tenella Traub and Morrow, 1955. (Figs. 61 – 67).




Figs. 55-60. Gahrliepia (in sp.) mirabilis Schluger, Grochovskaja, Tang Wang-ngu, Nguen Song-hoe and To King-tung, sp. n. 55) Larva from below. 56) Cephalic scutum. 57) Palp from the side. 58) First tibia from above. 59) Dorsal seta. 60) Ventral seta.

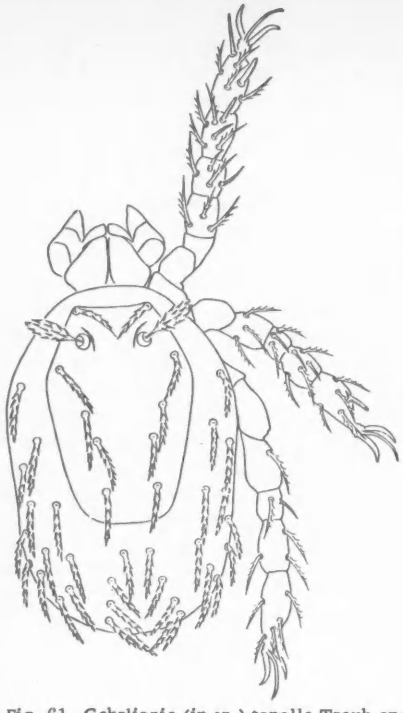
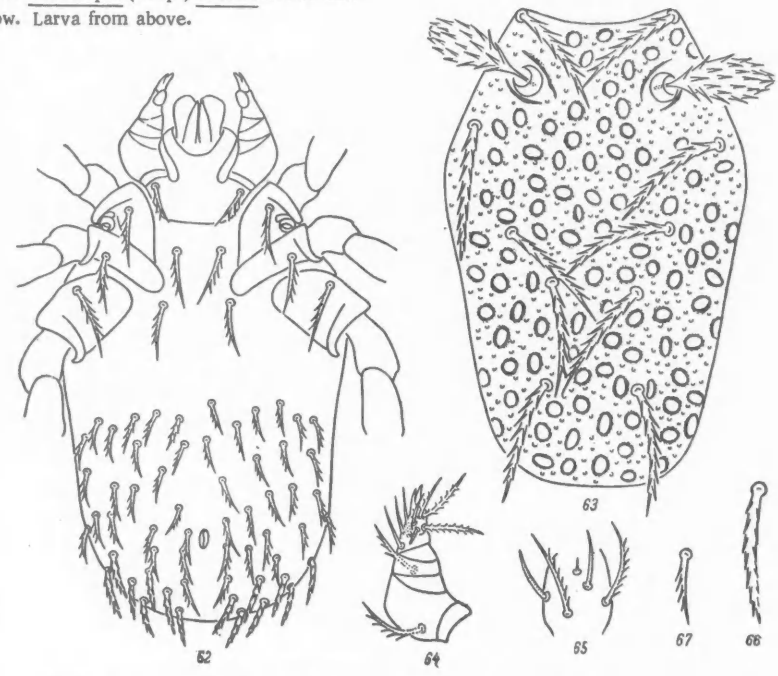


Fig. 61. Gahrliepia (in sp.) tenella Traub and Morrow. Larva from above.

Traub and Morrow, 1955, Smithson. mis. Coll. 128, 6 : 16–18.

Medium-sized mites. In starved and incompletely-gorged larvae the body is oval or elongate, with distinct or rounded shoulders. Cephalic scutum large, almost hexagonal in shape (1.4–1.5 times longer than its maximum width). Its anterior border is weakly concave, lateral borders, from the bases of the anterior setae, noticeably diverging posteriorly, and behind the bases of the posterior setae gradually converging toward a blunt posterior end. The surface of the scutum with a very peculiar pattern, consisting of large, oval, or roundish grains and a surface stippling (the latter is not always well-defined). The anterior pair of setae is in the corners of the scutum, the posterior pair on the lateral borders, and three pairs of accessory setae at a considerable distance from the lateral borders (usually they are disposed in two longitudinal rows). All the setae on the scutum are short, roughly of the same length. Trichobothria are flask-shaped, covered with fine, short hairs. Bothridia are near the lateral borders of the scutum, approximately at an equal distance between the bases of the anterior and the posterior setae. Crescent-shaped or linear combs surround the bothridia from the inner side. Eyes double, small (especially the posterior ones). Two scapular setae (one on each side),




Figs. 62–67. Gahrliepia (in sp.) tenella Traub and Morrow. 62) Larva from below. 63) Cephalic scutum. 64) Palp from the side. 65) First tibia from above. 66) Dorsal seta. 67) Ventral seta.

30–32 dorsal setae (in transverse rows of 4–6–6–6–4–2 (4)–2) and 48–58 ventral setae. Dorsal setae are short, densely covered with hairs of medium length. Medium-sized legs: 1st pair (without coxae) are 0.155–0.170 mm, 2nd pair 0.126–0.133 mm and 3rd pair 0.163–0.178 mm in length. The 3rd tarsus is 2.9–3.8 times longer than it is at its widest. The seta on the 3rd coxa is at a considerable distance from the middle of the anterior border. Two thin needle-like solenidien on the 1st tibiae (in the middle portion, almost at the same level with each other). Hypostomal setae smooth, long. On the palpal femur and tibia the setae are with fine, sparse hairs, which may be seen only with oil immersion; all the setae are smooth on the palpal tarsus.

Length of body is 0.222–0.326 mm, with a maximum width of 0.148–0.2 mm.

Length of setae (in mm): anterior 0.035–0.038, posterior 0.035–0.04 (average 0.038), dorsal 0.029–0.041 (average 0.034) and ventral 0.018–0.03 (average 0.022).

Distribution and hosts. Found on the border between China and Burma on the rat Rattus flavipectus yunnanensis (Anderson). In North Vietnam (Fu-Kui, Tan'-Hoa) found on Rattus sp.

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# REPORT ON WORK OF ALL-UNION ENTOMOLOGICAL SOCIETY, AFFILIATE OF THE ACADEMY OF SCIENCES, USSR, FOR 1959

Presidium of the All-Union Entomological Society
Translated from Entomologicheskoe Obozrenie, Vol. 39, No. 2, pp. 477-479, April-June, 1960

Organizational work. On January 1, 1959 the All-Union Entomological Society had 1498 active members (including 13 honorary and 90 junior members).

During 1959, 178 active members were admitted. Prof. S. I. Medvedev and Prof. V. N. Stark were elected as honorary members.

In 1959 the Society incurred heavy expenditure in connection with the deaths of 25 members, including two honorary members of the Society—Prof. V. I. Plotnikov, the oldest Soviet entomologist and one of the first research workers on the problem of plant protection in Central Asia, and Prof. S. S. Chetverikov, the eminent biologist and authority on Lepidoptera. The Society lost 191 active members, some by personal request, and some owing to long arrears of subscriptions and loss of contact with the Society.

On January 1, 1960 the Society numbered 1460 active members, including about 50 junior members.

On January 1, 1960, the All-Union Entomological Society had 18 sections: Moscow (President—Honored Scientific Worker D. M. Fedotov), Siberian (President—Doctor of Biological Sciences A. I. Cherepenov), Voronezh (President—Prof. P. A. Polozhentsev), Far Eastern (President—Prof. A. L. Kurentsov), Rostov (President—Candidate of Agricultural Sciences, V. P. Romanova), Ivanovo (President—Candidate of Medical Sciences N. V. Khelevin), Sakhalin (President—vacancy), Sochi (President—Candidate of Agricultural Sciences, K. M. Shishov), Ukrainian (President—E. V. Zverezomb-Zubovskii, Vice-President and Honorary Member of Society, Corresponding Member of the Academy of Sciences, Ukr. SSR), Belorussian (President—Candidate of Agricultural Sciences T. T. Bezdenko), Uzbed (President—Prof. V. V. Yakhontov, Corresponding Member of Academy of Sciences, Uzb. SSR), Kazakh (President—Prof. S. A. Kharin), Georgian (President—Prof. A. P. Kalandadze, Honorary Member of Society, Active Member of Academy of Sciences, Georgian SSR), Azerbaijan (under organization), Moldavian (President—Prof. Ya. I. Prints), Latvian (President—Prof. É. Ya. Ozols), Kirgizian (President—vacancy), and Turkmenian (President—Candidate of Biological Sciences A. N. Luppova).

Three meetings of the Society were held in Leningrad in 1959; particular interest was shown in Prof. D. M. Shteinberg's report on his journey to the International Symposium on the Ontogenetic Development of Insects in Prague and Dr. Novak's (Prague) paper on insect hormones.

The number of meetings of the Society cannot be regarded as adequate; more Society members must be induced to present papers. However, we should point out that the reduction in the number of meetings of the Society in Leningrad in the year under review, compared with previous years, was due to the considerable work involved in the preparation for the Fourth All-Union Entomological Congress in Leningrad (see below).

On April 8, 1959 the traditional N. A. Kholodkovskii Memorial Lectures were held. The following papers were read: "Prof. N. A. Kholodkovskii as a Darwinist and his predecessor-evolutionists in the Military Medical Academy" by Academician E. N. Pavlovskii, "Intraspecific relations of carnivorous gnat larvae of the subfamily Chaoborinae" by A. S. Monchadskii, and "Light traps as a method of collecting and studying insect disease-vectors", by T. D. Zhogolev.

The Council and Presidium of the Society held six meetings, at which the following questions were discussed: the convening of the Fourth All-Union Entomological Congress, the organization of the Far Eastern section of the Society, the compilation of a register of active members of the Society, the dispatch of the Society's publications to the Kirgizian section of the Society, and other matters. The Presidium of the Council also discussed the question of participation in the 11th International Entomological Congress in Vienna and approved the composition of the organizing committee for carrying out the preparatory work for the congress, namely: Chairman—Academician E. N. Pavlovskii, Deputies—Prof. M. S. Gilyarov, Corresponding Member G. Ya. Bei-Bienko, Corresponding Member V. V. Popov, Prof. A. A. Shtakel'berg, Prof. M. E. Ter-Minasyan, Prof. B. B. Rodendorf, Prof. D. T. Shteinberg, and Candidate of Biological Sciences A. G. Sharov.

Two meetings of the organizing committee for the convention of the Fourth All-Union Entomological Congress were held in Leningrad. The organizing committee discussed the question of the general lines and program of the congress, the possibility and advisability of publishing abstracts of proceedings of the congress. At its second meeting the organizing committee approved the program of work proposed by G. Ya. Bei-Bienko for the congress. The editorial board elected by the Presidium performed the great task of editing and preparing for the press the abstracts of papers sent to the organizing committee, a total volume of 30 signatures.

The composition of the Presidium was: the Society's President—Academician E. N. Pavlovskii (Editor-in-chief of Society's publications); Vice-Presidents—G. Ya. Bei-Bienko, Corresponding Member of the Academy of Sciences, USSR (editor of "Trudy VÉO"), E. V. Zverezomb-Zubovskii, Corresponding Member of the Academy of Sciences, Ukr. SSR; Presidium members—Doctor of Biological Sciences D. I. Blagoveshchenskii (Society Treasurer), Prof. A. N. Kirichenko (Scientific Librarian), V.V. Popov, Corresponding Member of Academy of Sciences, USSR, Prof. M. E. Ter-Minasyan, Prof. A. A. Shtakel'berg (editor of journal "Éntomologicheskoe Obozrenie"), Prof. D. M. Shteinberg, Candidate of Biological Sciences E. M. Shumankov; Scientific Secretary—Candidate of Biological Sciences O. L. Kryzhanovskii.

Editorial and publishing activities. In 1959 the editorial and publishing activity of the Society remained one of the basic aspects of the Society's work. During the year the 39th volume of the journal "Éntomologicheskoe Obozrenie" (4 numbers with a total volume of 60 signatures), two issues of "Abstracts of Proceedings of the Fourth Congress of the All-Union Entomological Society", and a collection "The Prof. N. A. Kholodkovskii Memorial Lectures", were published.

The "Éntomologicheskoe Obozrenie" during the year contained 123 papers and reviews by 103 authors, the papers being distributed in the following manner as regards content. The first issue contained a leading article "Tasks of entomology in the light of resolutions of the December Plenum of the Central Committees of the Communist Party of the Soviet Union"; general questions of entomology were dealt with in 20 papers and short articles; anatomy, morphology and embryology in three papers; biology in 39 papers, 15 dealing with agricultural pests, 11 with pests of medical or veterinary significance, 4 each to forest pests and the biological control of pests, and two to the biology of social insects; questions of faunistics and zoogeography were dealt with in four papers; one paper was devoted to methods of study; questions of systematics, including descriptions of new taxonomic units, were dealt with in 35 papers, ten of them on Coleoptera, eight on Diptera, four each on Hymenoptera and Coccidae, two each on Lepidoptera and Aphidae, one each on Orthoptera, Thysanoptera, Cicadidae, Mecoptera and Trichoptera. The journal contained five book reviews, a number which must be regarded as quite inadequate.

Of the articles and notes published in the journal during the year, 61 came from Leningrad, 12 from Moscow, four from Prague, three each from Kharkov and Irkutsk, one each from Petrozavodsk, Tartu, Voronezh, Talovaya, Gorki, Ivanovo, Gomel', Lvov, Kishinev, Stavropol, Krasnodar, Sukhumi, Ukhta, Nizhnii Tagil, Novosibirsk, Kzyl-Orda, Alma-Ata, and Warsaw. One issue of the journal was dedicated to the hundredth anniversary of the publication of Darwin's work "The Origin of Species".

The two issues of "Abstracts of Proceedings of the Fourth Congress of the All-Union Entomological Society" (total volume 30 signatures) contained 214 papers by Society members who proposed to participate in the Fourth Congress of the All-Union Entomological Society, January 26—February 1, 1960. The published issues of the "Abstracts" are illustrative of the research on general, agricultural, medical and veterinary entomology in the USSR, as well as on apiculture and sericulture.

The collection "The N. A. Kholodkoskii Memorial Lectures, 1956—1957" (5.6 signatures) contained five papers, based on those read at the ninth and tenth annual "Lectures" in 1956 and 1957.

Activity of Society Library. On January 1, 1960 the stock of the Society's library numbered 56,312 library units. The library stock in the current year has been supplemented with subscription items, purchases, and by exchanges with Soviet and foreign institutions. During the past year the library added 1319 library units, including 494 by direct exchange, 337 through the exchange stock of the Academy of Sciences Library, 227 by subscription, 36 by purchase, and 225 by presentation. The accessions for 1959 consisted of 261 monographs and 1058 periodical publications. Soviet literature contributed 426 library units, and foreign literature 893 library units.

In 1959 the Society library conducted direct exchange with 70 scientific institutions and societies in 22 countries, including Australia, England, Belgium, Hungary, the German Democratic Republic, the German Federal Republic, Holland, Indonesia, Spain, Canada, Mexico, Norway, the United Arab Republic, Poland, Rumania, the U.S.A., Finland, France, Czechoslovakia, Sweden, Yugoslavia, and Japan. Through the Library of the Academy of Sciences, USSR the Society conducted exchanges with 47 scientific institutions in 20 countries, including Austria, the Argentine, India, Italy, the Korean People's Republic, Switzerland, etc. Altogether, exchanges were made with scientific institutions and societies in 28 countries of the world.

In 1959 the Society library worked effectively for the service of its readers, both for Society members, and for non-members, including visiting specialists, students, and post-graduate research workers. The library was used by 194 persons altogether (including 78 from other towns), 1205 visits were recorded, and 8252 books were lent out.

Thirty-six books were issued for the Academy of Sciences, USSR and the M. E. Saltykov-Shchedrin State Public Library through the inter-library lending scheme.

No information has yet been received on the work of the Society's sections. We should mention the great work of the Ukrainian section, which on December 22—

25, 1959 in Kiev organized a republican conference on present-day entomological problems in the Ukrainian SSR to commemorate the 100th jubilee of the Society. For the conference a collection of papers "Problems of Entomology in the Ukraine" (volume of 18 signatures) was published. G. Ya. Bei-Bienko, Vice-President of the Society, visited the conference and gave an address on the theme "Some results of the work of the All-Union Entomological Society during the past 100 years and its present aims".

# REPORT ON THE PROCEEDINGS OF THE FOURTH CONGRESS OF THE ALL-UNION ENTOMOLOGICAL SOCIETY HELD IN LENINGRAD, JANUARY 26 – FEBRUARY 1, 1960

Presidium of All-Union Entomological Society, Affiliate of Academy of Sciences, USSR
Translated from Entomologicheskoe Obozrenie Vol. 39, No. 2, pp. 479-485, April-June, 1960

The Fourth Congress of the All-Union Entomological Society, coinciding with the 100th anniversary of the Society and convened by the Council of the Society and the Zoological Institute, Academy of Sciences, USSR was held between January 26 and February 1, 1960 in Leningrad; the All-Union Institute of Plant Protection of the All-Union Academy of Agricultural Sciences played a great part in the organization of the congress. The participants in the work of the congress numbered more than 700 entomologists, scientific workers, plant protection specialists, workers in production, teachers, and students, and included 11 Academicians and Corresponding Members, 66 Doctors and 305 Candidates. Representatives of more than 250 scientific and industrial institutions, colleges and other cultural and educational institutions and organizations took part in the work of the congress. Among these we should mention the Institutes of the Academy of Sciences, USSR (Zoological, Botanical, Animal Morphology, Geography, Biophysics, Palaeontology, Cytology, I. P. Pavlov Physiology, I. M. Sechenov Evolutionary Physiology, the Baikal Limnological Station), the zoology institutes and other zoological bodies of the Academy of Sciences of the Union Republics (Azerbaijan, Armenia, Belorussia, Georgia, Kazakhstan, Lithuania, Kirgizia, Tadzhikistan, Turkmenia, the Ukraine, and Estonia), the Siberian division and branches of the Academy of Sciences, USSR (Far Eastern, Kazan, Gorki, Dnepropetrovsk, Kiev, Leningrad, Lvov, Moscow, Rostov, Central Asian, Tartu, Tomsk, Uzhgorod, Uzbek, Kharkov, Chernovtsy), medical and veterinary institutes (Buryat, Voronezh, Ivanovo, Khabarovsk), teacher-training institutes (Andizhan, Kirov, Krasnodar, Krivorozh'e, Kuibyshev, Gertsen Leningrad, Michurinsk, Moscow, Moscow Regional, Orekhovo-Zuevo, State Correspondence, Ul'yanovsk), agricultural institutes (Ashkhabad, Barnaul, Blagoveshchensk, Velikie Luki, Gorki, Georgian, Kazan, Kazakh, Kishinev, Kurgan, Kursk, Leningrad, Lvov Odessa, Poltava, Tashkent, Uzbek, Kharkov, Kherson), forestry institutes (Belorussian, Bryansk, Voronezh, Lvov, Moscow), the Mendeleev Moscow Institute of Chemical Technology, the S. M. Kirov Military Medical Academy, the Timiryazev Agriculture Academy, and the S. M. Kirov forestry Academy. Also represented at the congress were 77 agricultural institutions, including the All-Union Institute of Plant Protection, the Moscow Grain Institute, the Ussurian, Tashkent, Fergana, and Samarkand State Plant Quarantine Boards, the Central Quarantine Laboratory of the Ministry of Agriculture, USSR, and several local laboratories, the All-Union Research Institute of Phytopathology, several plant protection and farming institutes, the Scientific Research Institute for Sugar Beet, and the All-Union Scientific Research Institute for Maize. Out of the 32 medical and veterinary institutions and organizations who sent representatives to the congress, we should mention the Black Sea Fleet Medical Service, the Institute of Virology and the Gamaleya Institute of the Academy of Medical Sciences, USSR, several institutes for medical parasitology and tropical medicine, public health stations, antiplague stations, and others. Among the 19 industrial organizations represented at the congress were the Fifth Moscow "Lesproekt" expedition, the Moscow factory "Nature and School", the Podgorenskaya, Tskaevskaya and Tobinskaya engineering repair stations, the Samarkand Regional State Farm Trust, and others. Also represented at the congress were the Nikita, Main and Batumi Botanical Gardens, several reserves, nature museums, the State Library, the editorship of the journal "Zashchita rastenii", the Laboratory for Preservation and Restoration of Documents, Academy of Sciences, USSR, and other institutions and organizations.

Other participants in the work of the congress were representatives of the Ministry of Agriculture, USSR and several of its boards (Andizhan, Voronezh, Dnepropetrovsk, Ivanovo, Krasnoyarsk, Odessa, Poltava, Khar'kov), the Ministry of Defense, USSR, the Central Board for Forestry and Timber Processing under the Council of Ministers, USSR, the Ministry of Agriculture of the Armenian SSR, and the Ministry of Agriculture of the Georgian SSR.

Besides those from Leningrad, the congress was attended by delegates from 90 cities, including Alma-Ata, Andizhan, Ashkhabad, Baku, Barnaul, Batumi, Vilnius, Vladivostok, Erevan, Irkutsk, Kaunas, Kiev, Kirov, Krasnoyarsk, Kursk, Kustanai, Lvov, Minsk, Michurinsk, Moscow, Novosibirsk, Odessa, Petrozavodsk, Perm, Riga, Rostov-on-Dov, Samarkand, Sverdlovsk, Sevastopol, Stalinabad, Sukhumi, Syktyvkar, Tallin, Tashkent, Tbilisi, Tomsk, Uzhgorod, Ulan-Ude, Ussuriisk, Frunze, Kharkov, Khabarovsk, Yakutsk, and many others.

Altogether, 244 papers were presented for the congress, and of these, 235 were accepted and published in two volumes in Leningrad in late 1959; nine papers could not be published owing to their late receipt.

At the congress 165 papers were heard and discussed. These papers can be grouped in the following categories corresponding to the sectional division of the work of the congress:

Papers of general import, read at the plenary sessions of the congress: E. N. Pavlovskii—"Insects and acari as an important element of biocoenoses in natural centers of diseases", E. M. Shumakov and D. M. Shteinberg—"Tasks of entomology in the Seven-Year Plan", E. S. Smirnov—"Theoretical principles of classification", D. M. Fedotov—"Phylogenetic relations in the class Insecta and in the arthropod type in general", B. B. Rodendorf—"Current information on insect classification", A. S. Danilevskii—"Ways and methods of employing ecological and faunistic data in the analysis of phenological and ecologogeographical laws", T. G. Grigor'eva—"Basis of methods of protecting grain crops from pests in the zone of cultivation of virgin and long-fallow lands", S. I. Medvedev—"Landscape variation in the territory of the USSR and large-scale pests (as exemplified by the forest-steppe and steppe zones)", V. N. Stark—"The effect of forest cultivation measures in woodland on the dynamics of insects injurious to crops", B. V. Dobrovol'skii—"Theory of focalization of diseases and its application to phytophagous insects", T. Ya. Polyakov—"Nature of population fluctuations of insect pests and factors governing them", G. A. Viktorov—"The biocoenosis and questions of insect numbers", N. A. Talenga—"The most important ways of studying entomophages in relation to the problem of biological pest control", Ya. I. Prints—"Study of the resistance of plants to insects and mites in connection with the breeding of resistant forms", I. A. Churaev, "The present state and aims of protection of the territory of the USSR from quarantine pests", G. M. Razvyazkina—"Role of insects in the spread of viruses and the development of viral epizootics", and G. A. Mazokhin-Porshnyakov—"New information on insect color vision".

At the first plenary session G. A. Bei-Bienko's address "One hundred years of the All-Union Entomological Society (1859–1959)" was read.

General entomology. The following papers were heard in the general entomology section: M. S. Gilyarov (Moscow)—"Special features of complexes of soil-dwelling insects in the main soil zones of the European USSR," M. M. Aleinikova (Kazan)—"Soil fauna of the Tatar ASSR and some regular aspects of its development", I. V. Stebaev (Moscow)—"Development of complexes of soil-dwelling insects and other invertebrates in the course of the primary soil formation process", E. M. Zakhvatkina (Moscow)—"Review of investigations on the oribatid mites of the USSR", V. G. Shurovenko (Velikie Luki)—"Fluctuations in the numbers of injurious click-beetles in the steppe zone", D. M. Shteinberg (Leningrad)—"Value of experimental morphology methods for problems of insect phylogeny", B. B. Rodendorf (Moscow)—"Palaeoentomology and its development", O. M. Martynova (Moscow)—"Palaeontology and the study of present-day insects", A. G. Sharov (Moscow)—"The origin of the order Plecoptera in the light of new palaeontological data", S. I. Malyshev (Leningrad)—"Appearance of flowering plants as a result of the evolution of functions of bee ancestors", O. M. Bocharova-Messner (Moscow)—"Main trends in the evolution of the flight apparatus of insects", Yu. M. Zalesskii (Moscow)—"Study of evolution and functional principles of insect flight and its practical value, L. M. Semenova (Moscow)—"Structural features of the cuticle of aquatic insect larvae as an adaptation to conditions of existence", B. M. Mamaev (Moscow)—"Morphophysiological features of insect larvae developing in rotten wood", L. V. Puchkova (Kiev)—"Main trends of evolution of eggs of the true bugs (Hemiptera-Heteroptera)", N. N. Filippov (Moscow)—"Regular features in the aberrant variation of the pattern on beetle elytra", V. A. Zaslavskii (Leningrad)—"Some trends of adaptive evolution in the superfamily Curculionoidea", E. S. Milyanovskii (Sukhumi)—"Aspects of the distribution of some species of Lepidoptera in low-lying areas of the USSR and the mountain region of the Caucasus (Abkhazia)", L. V. Arnol'di (Leningrad)—"On the biogeographical division of Central Kazakhstan on the basis of ecological and biocoenotic researches in entomology", A. L. Kurentsov (Vladivostok)—"The origin and main stages of development of the Manchurian insect fauna", A. I. Cherepanov (Novosibirsk)—"Formation of insect fauna in Western Siberia in the Post-Tertiary period", D. V. Panfilov (Moscow)—"Landscape distribution and history of formation of insect fauna of the central Tien Shan", A. A. Bundel' (Moscow)—"The question of the formation of the modern Lepidopteran fauna of the Pamirs", A. N. Luppova (Ashkhabad)—"Termites of Turkmenistan and termite prevention", S. L. Medvedev (Khar'kov)—"Interrelationship of insect faunas of the Crimea and northwest Caucasus", I. K. Lopatin (Stalinabad)—"Insect fauna and ecological groupings of insects of the broad-leaved woods of Gissaro-Darvaz", Yu. I. Chernov (Moscow)—"Features of the landscape distribution of insects in the tundra of Vaigach and Yugor Pen.", N. M. Voskresenskii (Kurgan)—"Features of the Lepidopteran fauna of Southern Transuralia", P. Zayanchkauskas (Vilnius)—"Materials for a study of the sawfly fauna (Tenthredinoidea) of the Lithuanian SSR", A. I. Protsenko (Frunze)—"Main aspects of the lemellicorn fauna of Kirgizia", V. K. Stroganova (Novosibirsk)—"Sawflies and horntails of West Siberia", L. A. Arens and E. L. Arens (Teberda)—"Interdependence in the systematic position of species of Sphecidae and their victims", and V. S. Odintsov (Moscow)—"Some problems of entomology and aviation".

The following papers were heard at the special sessions on questions of insect physiology: N. I. Goryshin (Leningrad)—"Perception of light stimuli with reference to the mechanism of photoperiodic reactions of insects", A. V. Getsova (Leningrad)—"Uptake of various radioisotopes by aquatic insects", L. D. Strel'nikov (Leningrad)—"Significance of body size of insects in their structure, physiology and environmental relations", M. E. Lobashev, N. G. Lopatina, L. A. Nikitina and E. G. Chesnokova

(Leningrad)—"Physiological mechanism of orientation of the bee Apis mellifera L. in space", A. S. Kosmachevskii (Krasnodar)—"Dependence of insect development on water", and G. A. Pantyukhov (Leningrad)—"Temperature adaptations of geographical forms in some insects".

The following papers were heard at joint sessions of the general, agricultural, forest, medical and veterinary entomology sections on questions of method: A. A. Lyubishchev (Ul'yanovsk)—"Statistical methods in entomology", A. A. Peredel'skii and L. O. Bogatyrev (Moscow)—"An indicator method of determining sites of increased radioactivity in the field from insect collections", E. M. Shumakov, N. M. Edel'man and A. E. Borisova (Leningrad)—"Rearing of phytophagous insects on artificial media", G. A. Beglyarov and V. L. Tanskii (Leningrad)—"Methods of studying certain small plant inhabiting arthropods", G. A. Zinov'ev (Leningrad)—"Demarcation and mapping of biocoenoses and their insect complexes", G. V. Serdyukova (Leningrad)—"Methods of parasitological mapping of landscape biocomplexes", and S. G. Kozhevnikov (Krasnoyarsk)—"Work of the Crop Pest and Disease Survey and Prediction Service".

In their resolutions on general questions the congress noted that a considerable amount of valuable research on the fauna of the USSR, particularly on groups of great economic significance, had been carried out and the results published in recent years. The Zoological Institute, Academy of Sciences, USSR had done a great deal in this respect. However, in view of the fact that the study of the fauna of the USSR was still far from complete, that many groups of insects had not been studied at all, that there were no comprehensive works on other groups, and also that our country required highly-qualified faunists and taxonomists, the congress recommended that the Academy of Sciences, USSR and the Academies of Sciences of the Union republics, and colleges as well, should aim at an all-round expansion of research in the fields of faunistics, systematics, ecology and geography in line with the work of the central institution of our country, the Zoological Institute.

The congress noted that our country was lagging far behind foreign science in the fields of experimental ecology and the physiology of insect development, branches of science which are absolutely essential for the solution of the important theoretical and practical problems confronting Soviet entomology.

Agricultural entomology. The following papers were heard in the agricultural entomology section: I. D. Batiashvili (Tbilisi)—"The present state of research on fruit crop pests in Georgia and ways of solving some scientific problems", A. A. Popova (Leningrad)—"Types of adaptation of insect phytophages to feeding on host plants", M. A. Sosnina (Samarkand)—"Elaboration of control measures against pests of desert and semidesert pastures in Uzbekistan", E. P. Tsyplenkov (Leningrad)—"The locust problem in the USSR", M. P. Mal'kovskii (Alma-Ata)—"The state of the locust problem in Kazakhstan", T. Tokgaev (Ashkhabad)—"Outbreaks of the Moroccan locust in the foothill regions of Turkmenia and their causes", I. D. Shapiro (Leningrad)—"The present state and prospects of devising a system of measures to protect maize from insect pests in the northern regions of the USSR", P. I. Susidko (Dnepropetrovsk)—"Results and perspectives of research on control methods against the European corn borer", I. I. Soboleva-Dokuchaev (Moscow Region)—"Maize pests in the non-chernozem zone", L. S. Ul'yanova (Tashkent)—"Maize pests and the biology of Polia dissimilis Knoch, in Uzbekistan", L. P. Kalandadze and I. A. Chelidze (Tbilisi)—"Some results of research on the grain moth (Sitotroga cerealella Ol.) in field conditions in Georgia", N. M. Utrobina (Kazan)—"Experience of employing BHC and organic phosphorus preparations for control of wireworms and some other maize pests", V. A. Rider (Voronezh)—"Mechanized introduction of small doses of BHC dust along with fertilizers for the control of wireworms and false wireworms* damaging maize and sunflower", N. G. Erim (Leningrad)—"Laws of synergism manifested in the combined application of insecticides", A. L. Popova (Sochi)—"Effectiveness of combinations of chemical substances with leaf top dressings", B. I. Rukavishnikov (Moscow)—"Combination of chemical control and the conservation of useful insects", A. A. Brudnaya (Moscow)—"Mechanized fumigation of pest-infested grain", I. D. Shapiro and S. G. Zhukovskii (Leningrad)—"Causes of varied regional resistance of wheat to fruit fly", K. I. Popov (Kazan)—"Biological principles of crop tolerance to injury by leaf-eating insects", O. I. Petrukha (Kiev)—"Present state and aims of sugar beet pest control in the USSR", A. I. Zrazhevskii (Kiev)—"Conditions of development of beet weevil in soil and control measures against it", B. A. Gerasimov (Moscow Region)—"Present state and perspectives of elaboration of a system of measures for protecting vegetable crops from pests", M. F. Tropkina (Leningrad)—"The potato moth (Phthorimaea operculella Zell.) and its quarantine significance for the USSR", A. S. Babayan (Erevan)—"Selectivity of Gelechia malvella Hb.", V. V. Vasilyan (Erevan)—"Effect of x-rays on some biological features of Pectinophora malvella Hb.), A. N. Kokorin (Leningrad)—Biological basis of agrotechnical measures for protecting clover against the stem weevils Apion virens Hbst. and Apion seniculus Kirby", Ya. I. Prints (Kishinev)—"The phylloxera problem", N. Kh. Kiskin (Kishinev)—"Aspects of the damage caused to vines by phylloxera and to apple by the woolly apple aphid", I. Z. Livshits (Crimean Region)—"Chemical control of orchard pests—the deciding factor in raising the yield and improving the quality of fruits", V. I. Deryabin (Samarkand Region)—"Comparison of damage inflicted on different varieties of apples by the codling moth", V. V. Smol'yannikov (Kislovodsk)—"The San Jose scale (Diaspidiotus perniciosus Comst.) in Stavropol Province and the elaboration of a system of control measures against it", and L. A. Stradimova (Lvov)—"Possibility of the spread

*Larvae of Tenebrionidae and Alleculidae (Trans.).

of the fall webworm in the conditions of the Carpathian region of the Ukrainian SSR".

In a resolution of the congress it was noted that, although considerable progress had been made in the elaboration and adoption of control measures against several serious pests of valuable crops, there were still grave shortcomings in the matter of pest control, and the removal of these was essential for the further progress of agricultural entomology.

A very important task of all members of the Society is to participate as far as possible in publicizing the results of scientific research and the experience of advanced farms, and in their application on a wide scale by collective and state farms.

As regards the protection of plants from pests particular regard must be paid to the specialization of natural economic regions for the production of a particular kind of agricultural product, which results in the crop rotation being dominated by one type of crop, and which can lead to a considerable accumulation of specialized pests on the fields. In view of this such regions and farms must be provided in the first place with all the necessary means of control, and labor expenditure must be greatly reduced by full mechanization of the care of the plants and the introduction of square-cluster siting of the plants (maize, sugar beet, melons, etc.); in these conditions special significance attaches to pest control as a method of preventing thinning-out of the sowings. For this purpose it is essential to speed up the provision of farms with preparations of the diene synthesis and enriched BHC for dusting of the seeds prior to sowing. For the considerable improvement of the control of pests of field crops, orchards and vineyards the congress outlined several practical measures bearing on maize pests, harmful locusts, sugar beet pests, orchard pests, phylloxera, storehouse pests, vegetable pests, etc.

Forest entomology. The following reports were heard: M. T. Lavrov (Bryansk)—"Effect of forest type and associated mechanical and chemical composition of soil on the distribution of the western (Melolontha melolontha L.) and eastern (Melolontha hippocastani L.) May beetles in the region of contact of their ranges", P. G. Troshanin (Bryansk)—"Estimation of results of damage to forests by the May beetle", A. A. Prisyazhnyuk (Minsk)—"Application of DDT and BHC preparations for control of chafer larvae in woods of the Belorussian SSR", A. I. Kurentsov and D. G. Kononov (Vladivostok)—"Bark beetles of the Kamchatka peninsula", L. A. Ivliev and D. G. Kononov (Vladivostok)—"Some large-scale pests of Kamchatka forests", N. I. Mel'nikova (Moscow)—"Secondary pests of spruce and their control in woods around Moscow", M. M. Loginova (Leningrad)—"Jumping plant lice (Psylloidea, Homoptera) of Kazakhstan and Central Asia and their economic significance". N. N. Egorov—"Age differences in buprestid larvae". B. V. Ryvkin (Gomel')—"The pine bark bug (Aradus cinnamomeus Panz.) and its natural enemies", P. M. Rafes (Moscow)—"Typology of breeding centers of forest pests". E. I. Slepyan (Leningrad)—"Some general questions of gall midge study with reference to special features of the biology of gall-formers and the structure of galls", P. P. Okunev (Leningrad)—"Dendrolimus sibiricus Tschtw. and the protection of damaged tree stands", N. A. Krasil'nikov and A. B. Gukasyan (Moscow)—"Species composition of the microflora of Dendrolimus sibiricus Tschtw.", L. A. Ivliev (Vladivostok)—"Ecology of Dendrolimus sibiricus Tschtw. and the successions caused by it in forests of the Far East", G. O. Krivolutskaya (Novosibirsk)—"Development of concealed trunk pests in centers of Dendrolimus sibiricus Tschtw. in Western Siberia", N. G. Kolomiets (Novosibirsk)—"Forest entomophages of Western Siberia and perspectives of their utilization", and V.O. Boldaruev (Krasnoyarsk)—"Role of parasitic insects in the multiplication of Dendrolimus sibiricus Tschtw.".

The resolutions on forest entomology indicated the main measures for the care of woodland: The further development of methods of exterminating the principal large-scale pests must be accompanied by an intensification of investigations aimed at providing resistant plantations and increasing the resistance of those already in existence, with special attention being given to research on useful insects (parasites and predators) and to the devising of forestry methods of control, and also to diseases of the dendrophilous inhabitants of the forest. More intensive research on trunk pests was required. The attention of forest research organizations should be directed toward the need for urgent study of the whole group of pests of seeds, primarily of conifers, and also to the elaboration of measures for the protection of the seed yield. More work must be done on the protection of seedlings and young plantations before they close up. Plant protection institutes and institutes of the Academy of Sciences, USSR, were urged to make provision for an all-round development of research on crop pests (especially of grain) in areas occupied by forest, with special reference to the group of soil root pests. The study of biocoenoses on unafforested areas must be expanded. There must be an intensification of research aimed at ensuring a complete prognosis of mass outbreaks of forest pests, and hence the elimination of breeding centers at the initial stage of their formation, and also of investigations on the estimation of losses, and the assessment of the efficacy of measures.

Biological control of pests. The following papers were discussed: I. A. Rubtsov (Leningrad)—"Primary aims in the study of entomophages". V. A. Shchepetel'nikova (Leningrad)—"Behavior of imaginal phase as a factor affecting the efficiency of entomophages in biological plant protection", M. I. Matveeva (Tashkent)—"Importance of supplementary feeding for different biological groups of ichneumons", K. V. Kamenkova (Leningrad)—"Efficiency of the complex of parasites of the grey cutworm (Hadena anceps Bkh.) from observations in the Karabalyk District of Kustanai Region", V. A. Shapiro (Leningrad)—"Role of parasites of the grain cutworm (Hadena) and perspectives

for increasing their efficacy", B. M. Chumakova (Leningrad)—"Siting of nectar-bearing herbs in orchards as an agrotechnical method of increasing the effectiveness of parasites of the San Jose scale", Kh. G. Kopvillem (Moscow)—"Biological and ecological features of Ernestia consobrina Mg., a parasite of the cabbage moth Barathra brassicae L., and perspectives of its utilization", G. G. Kurbanov (Baku)—"Entomophages of Gelechia malvella Hb. and the cotton spider mite (Tetranychus urticae Koch.) and prospects of utilizing them in the Nakhichevan ASSR", N. L. Bogdanova (Frunze)—"An ichneumon parasite of the codling moth", L. S. Sytenko (Leningrad)—"Parasites of the fruit moths Grapholitha, Tmetocera, Carposina and Hyponomeuta sp. in the Maritime Province", R. P. Karavaeva and K. E. Romanenko (Frunze)—"Parasites of moths of the genus Hyponomeuta in woods of south Kirgizia", E. S. Kir'yanova (Leningrad)—"Account of research on helminths of Hyponomeutidae in woods of south Kirgizia", V. Ya. Shiperovich (Petrozavodsk)—"Coenotic interrelationships of pests in the forests of Karelia", E.S. Sugonyaev (Leningrad)—"Chalcids (Hymenoptera, Chalcidoidea)—parasites of mealybugs and scales (Homoptera, Cocoidea) of Leningrad Region", V. A. Yasnoth (Tbilisi)—Chalcid parasites of mealybugs and scales in the forests of east Georgia", A. N. Luzhetskii (Tashkent)— "Parasites of plant lice of the family Aphidiidae in Uzbekistan", and P. A. Polezhentsev (Voronezh)—"Insects and their helminths".

A resolution of the congress on biological control of pests recommended the application of biological control against Euxoa segetum Schiff. and other cutworms, and against the codling moth and pests of vegetable and citrus crops. The congress stressed the need for expansion of scientific research in this field and its first-ranking importance.

Social and useful insects. The following papers in this group were heard: A. N. Mel'nichenko (Gorki)—"Nature of signaling movements of bees and ways of controlling their flying activity", L. A. Levchenko (Kiev)—"Apparatus for recording conditioned reflexes in domestic bees", A. F. Sheremet'ev (Gorki)—"An ecological and genetic characterization of honey bee populations of the northeast European SSSR", S. I. Malyshev (Leningrad)—"An unusual mode of egg-laying in primitive bees of the genus Colletes (Hymenoptera, Colletidae)", K.P. Istomina-Tsvetkova (Ryazan Region)—"Trophic interrelations of honey bees", S. G. Bogoyavlenskii (Voronezh)—"Behavior of bees in the field and their protection from poisoning by insecticides", N. N. Blagoveshchenskaya (Ul'yanovsk)—"Bees of Ul'yanovsk Region and their biology", A. A. Ponomareva (Leningrad)—"Habitat distribution of bees of western Kopet-Dag", G. A. Avetisyan (Moscow)—"Some regular features in the evolution of social insects", and P. I. Marikovskii (Tomsk)—"Some features of the behavior of the wood ant (Formica rufa L.), indicative of the form and state of its communal life".

The congress outlined several measures relating to the improvement of cross-pollination of entomophilous plants by bees and to increasing the production of honey and other valuable products of apiculture.

Medical and veterinary entomology: The following papers were read and discussed: S. A. Shilova (Moscow)—"Pattern of population fluctuations in the tick Ixodes persulcatus P. Sch. and its hosts as a prerequisite for epidemiological prognoses in centers of tick-borne encephalitis", V. I. Chabovskii (Moscow)—"Importance of active and passive migrations of the tick Ixodes persulcatus P. Sch. in centers of tick-borne encephalitis", L. A. Rubtsov (Leningrad)—"Effect of pollution and purification of waters on the numbers, habitat-distribution and attacking activity of blackflies", S. N. Zvyagintsev (Moscow)—"Effect of newly created reservoirs on the bloodsucking fly fauna", A. V. Dolmatova (Moscow)—"Geographical distribution of sandflies (Phlebotominae), O.N. Sazonova (Moscow)—"Mosquitoes of the genus Aedes and their ecology in the flood-plains of rivers of the European SSSR", L. V. Ivanova (Moscow)—"Chemoreceptors of bloodsucking gnats of the family Culicidae", B. P. Savitskii (Minsk)—"Experience of employing BHC dust for control of bloodsucking arthropods in Belorussia", A. V. Gutsevich and A. L Vigovskii (Leningrad)—"Research on midges in the Carpathian zone and their possible epidemiological significance", Kh. Ya. Remm (Tartu)—"Feeding ecology of biting midges (Diptera, Heleidae)", O. F. Buyanova (Moscow)—"Some data on the biology of bloodsucking midges of the genus Lasiohelea in Krasnoyarsk Province", A. V. Maslov (Khabarovsk)—"Fauna and zoogeography of bloodsucking flies of the Far East", K. V. Shuf'in (Voronezh)—"Zonal features of the ecology of horseflies (Tabanidae, Diptera)", K. A. Breev (Leningrad)—"Biological principles of bot- and warble-fly control", K. A. Breev and K. Ya. Grunin (Leningrad)—"Extent of loss of hide, meat and milk due to cattle warbles", L. F. Romasheva (Frunze)—"Features of the development of warble-fly larvae in calves", N.A. Chereshnev (Frunze)—"Aerosol control measures against bot flies of farm animals", N. A. Skavinskii (Baranovichi)—"Pests of stored food in Baranovichi and their species composition", V. P. Derbeneva-Ukhova (Moscow)—"Ecological classification of synanthropic flies of the families Muscidae and Calliphoridae", V. P. Derbeneva-Ukhova (Moscow)—"Regular features in the development and loss of resistance of Musca domestica L. to insecticides in the laboratory and in nature", K. B. Gorodkov (Leningrad)—"Flies of the Helomyzidae as synanthropes", V. A. Lineva (Moscow)—"Changes in ovogenesis of the house fly (Musca domestica domestica L.) under the action of insecticides", M. N. Sukhova and T. V. Erofeeva (Moscow)—"Causes of the inefficacy of disinfection measures in the case of house flies", E. B. Kerbabaev (Ashkhabad)—"Notes on bloodsucking Acarina of Turkmenia", G. V. Ushakova (Alma-Ata)—"Species composition and distribution of izodid ticks in the lower reaches of the R. Ili", V. N. Kusov (Alma-Ata)—"Some features of the distribution of

ornithodorine ticks in Kazakhstan", B. Kadite and L. Éitminavichyute (Vilnius)—"Historical review of acarological research in the Lithuanian SSR", and A.T. Gadzhiev (Baku)—"Gamasid mites of the rodents of Azerbaijan".

The congress indicated the need for wide research on the greatest possible number of groups of insects and mites injurious to man or causing damage to stock.

The congress noted that effective control measures had now been devised against several pests of plants and animals and insect enemies of man, and that measures for reducing the damage inflicted had also been developed. These measures, however, had not been sufficiently widely adopted in practice, even though their introduction could greatly raise the productivity of agriculture and forestry and improve the health of man and domestic animals. The congress resolved to draw up proposals to bring about the adoption of such measures in the national economy and public health work.

The full text of the resolutions of the congress will be published in a separate volume in the very near future.

The congress heard and discussed the report of the Presidium of the All-Union Entomological Society, the report of the inspection committee and reports of the Siberian, Ukrainian and Uzbek sections of the Society. The congress congratulated the Presidium of the Society on its work on scientific organization and on its publishing activity.

The Society Council was elected at the Fourth Congress of the All-Union Entomological Society and had the following composition:

1) I. D. Batiashvili
2) G. Ya. Bei-Bienko
3) N. S. Borkhsenius
4) V. P. Vasil'ev
5) G. A. Viktorov
6) M. S. Gilyarov
7) K. Ya. Grunin
8) A. V. Gutsevich
9) A. S. Danilevskii
10) L. P. Kalandadze
11) A. N. Kirichenko
12) S. G. Kozhevnikov
13) A. F. Kryshtal'
14) A. L. Kurentsov
15) A. N. Luppova
16) O. M. Martynova
17) S. L. Medvedev
18) M. N. Narzikulov
19) E. Ya. Ozols
20) E. N. Pavlovskii
21) P. A. Polozhentsev
22) V. V. Popov
23) Ya. I. Prints
24) B. B. Rodendorf
25) V. P. Romanova
26) N. G. Samedov
27) E. S. Smirnov
28) V. N. Stark
29) S. P. Tarbinskii
30) M. E. Ter-Minasyan
31) V. I. Tobias
32) R. S. Ushatinskaya
33) D. M. Fedotov
34) Kh. M. Khaberman
35) A. L. Cherepanov
36) A. A. Shtakel'berg
37) D. M. Shteinberg
38) E. M. Shumakov
39) V. N. Shchegolev
40) V. V. Yakhontov

At the first session of the Society Council on February 1, 1960 the Presidium of the All-Union Entomological Society was elected with the following composition:

1) E. N. Pavlovskii—President, Editor-in-chief of publications of the All-Union Entomological Society
2) G. Ya. Bei-Bienko—Vice-President,
3) D. M. Shteinberg—Vice-President,
4) V. P. Vasil'ev—Vice-President,
5) A. A. Shtakel'berg—Deputy Editor-in-chief of the journal "Éntomologicheskoe Obozrenie",
6) A. S. Danilevskii,
7) V. V. Popov,
8) M. E. Ter-Minasyan,
9) E. M. Shumakov.

V. I. Tobias was elected as Scientific Secretary, and K. Ya. Grunin as Treasurer. B. M. Berezina, V. A. Tryapitsin, and I. A. Chetyrkina were elected as members of the inspection committee.

# A NEW ENTOMOLOGICAL PUBLICATION

Z. D. Spuris

Translated from Entomologicheskoe Obozrenie Vol. 39, No. 2, pp. 486, April-June, 1960

The Latvian section of the All-Union Entomological Society is now publishing a new series on entomology—"Latvijas Entomologs" ("Latvian Entomologist"). The main aims of this series are to make known the results of the scientific work of members of the Latvian section, and to publicize entomological information. It will print papers on a great variety of entomological problems, but will be devoted mainly to the faunistics and ecology of insects. A limited amount of space will be given over to papers on other groups of arthropods. Besides the larger original papers there will be short scientific communications. A "Current Events" and "Book Review" section are also envisaged. In the forthcoming years individual issues, each with a volume of about four to six signatures, will be published irregularly, once or twice per year. Publication will be mainly in the Latvian or Russian languages with a summary in a foreign language. The address of the editor is: Riga 7, Kleisti, Institute of Biology, AN Latv. SSR.

The first number has already been published. It includes the following papers: "Scale insects injurious to ornamental trees and shrubs in the Latvian SSR," "Modes of defense and reproduction of the wood ant", "Results of testing new insecticides for wireworm control on maize fields", "New data on the Psocids of the European USSR", "Halticinae of the genus Phyllotreta Foundr. in the Latvian SSR", "Caddisflies of L. Usma", "Variability of wing venation in dragon flies of the genus Leucorrhinia Britt.", and others. The price of the first number is 2 roubles 50 kopeks.

# REVIEWS AND BIBLIOGRAPHY

## A BIBLIOGRAPHY OF SOVIET WORKS ON VIRUS DISEASES OF INSECTS

S. M. Gershenzon

Insect virus diseases are an important natural factor limiting the numbers of many serious agricultural and forest pests; in recent years successful experiments have been carried out in various countries on combating injurious insects by means of provoking virus epizootics within their populations. Entomopathogenic viruses cause heavy losses in sericiculture and apiculture. On the strength of several of their characteristics, viruses infecting insects serve as convenient subjects for investigating some general virological problems. The great practical and theoretical importance of entomopathogenic viruses has drawn the attention of entomologists, sericiculturists, apiculturists, and virologists; the number of published works devoted to the study of these viruses and the diseases they cause grows each year. In the last ten years several surveys have been published abroad, provided with lists of the scientific literature available in this field: G. H. Bergold, "Insect viruses" (in the collection: Viruses 1951, Pasadena, 1950); G. H. Bergold, "Insect viruses" (in the collection: Advances in Virus Research, I, 1953); G. H. Bergold, "Viruses of insects" (in Handbuch der Virusforschung 4, Vienna, 1958); E. Jahn, Insektenviren (Leipzig, 1958); and K. M. Hughes, "An annotated list and bibliography of insects reported to have virus diseases" 26 (Hilgardia, 1957). Unfortunately the works of Soviet scientists are extremely poorly reflected in these lists. At the same time, the investigations of Soviet authors occupy a conspicuous place in the world literature on entomopathogenic viruses, both in numbers and significance. The bibliographic index here appended is intended to correct this omission. We have attempted to include in this list all Soviet works on virus diseases of insects, as far as possible. The list does not include those works in which entomopathogenic viruses or the diseases they cause are only mentioned, popular descriptions of insect virus diseases in widely distributed brochures and manuals of sericiculture and apiculture which do not contain original data or conclusions, and works translated from foreign languages.

At the end of the bibliography there is a list of the species of insects the virus diseases of which are discussed in the works included in the bibliography; the numbers correspond to the consecutive numbers of the citations. All works except those relating to the honey bee (Apis mellifera L.) discuss nucleic polyhedral viruses and the diseases they cause. The works on bees are concerned with sacbrood. We were unable to discover Soviet works devoted to any other entomopathogenic viruses (Cytoplasmic polyhedrosis, granulosis, etc).

The compiler would be grateful for any communications concerning possible omissions in the list, sent to him at the following address: Kiev 30, Vladimirskaya 55, Institute of Zoology, Academy of Sciences of the Ukrainian SSR.

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Entomology is presently one of the most extensive of the biological sciences. In the number of published works (more than 4,000 papers a year) entomology is in first place among the zoological sciences. This is explained not only by the extraordinary specific variety shown by insects but also by their enormous importance in the economy of nature and in the agricultural activities of man. The agriculture of the United States suffers a yearly loss from harmful insects of $4,068,000,000, which comprises 5.8% of the national budget (this and the other statements presented below were taken from the foreword and main text of the book being reviewed). Losses from harmful insects in the world as a whole are not lower, but rather highter on the average, than those cited above for the USA. The beneficial role of insects is no less important, especially that of pollinators and entomophages. If we could imagine the total disappearance of insect pollinators and entomophages over the entire planet (which occurs to a large extent now over the tens of millions of hectares treated by insecticides), this would spell a veritable catastrophe for the organic world. A large proportion of the flowering plants would disappear and the remainder would be quickly annihilated by the countless numbers of plant-eating insects. Their multiplication is held in check primarily by entomophagous insects. Expenditures for the control of harmful insects with insecticides have already reached impressive figures. An extensive branch of chemical industry producing insecticides arose and is rapidly developing. A large number of new, highly toxic chemical poisons appeared. Their catalogs contain hundreds of names and each year dozens of new ones appear. In the USA from 1952–1954 the treatment of fields with chemical poisons involved more than 7,000 planes, which sprayed and dusted about 12–16 million hectares, the total area treated being as much as 24 million hectares, with one quarter of this area treated more than once.

The most remarkable aspect of this, however, is that the widespread use of chemical control and the application of the most up-to-date and effective insecticides have not resulted in any reduction in the necessity for yearly control measures against harmful insects; on the contrary, from year to year expenditures in this field increase and the problem becomes ever more acute; the cessation of chemical control now results in many cases in serious local threats and even the complete loss of the harvest. The biological explanation of this seemingly paradoxical phenomenon is to be found in the double-edged nature of the application of chemical poisons. The majority of the insecticides applied so far are not very selective; together with the harmful insects they annihilate the beneficial entomophages which used to check the increase of several pests. The results are previously unknown outbreaks of old and new pests and a newly arisen necessity for yearly application of poisons. In addition to this, a phenomenon which has acquired great importance is the habituation and resistance of insects to poisons, which sometimes has arisen as early as during the laboratory testing process for insecticides or as late as its extensive application under field conditions. During the short post-war period resistance to poisons has arisen in more than 110 species of arthropods, and their number grows every year. In some spider mites in the USA resistance, in some degree, has been developed to 80 chemical poisons with different modes of action. A way out of this situation is perceived in the replacement of old chemical poisons by new ones, in the discovery of selectively acting insecticides or in their application in such a manner that only the harmful insects are destroyed and the beneficial ones (entomophages and pollinators) preserved, and also in an expansion of the practice of chemical control. On the other hand, following upon the widespread introduction of highly toxic organic and organic phosphate compounds and in direct relation to the negative consequences of chemical control, the idea is developing of placing insect control measures on a biological basis. After the chemical study of insecticides, methods are beginning to be implemented for the preservation, accumulation, distribution, and application of beneficial entomophages for biological control. The cheapness, prophylactic nature and selectivity of action of entomophages, the absence of the harmful consequences characteristic of chemical control methods, and several tangible practical successes have drawn attention to the question of biological plant protection. In the USA and Canada in the last two or three decades more than 500 species of beneficial insects have been introduced, of which about 100 have become acclimatized. About 90 species of important pests have been economically satisfactorily controlled with the help of entomophages. Following the experience of Canada and the United States, all the major West European countries have created modern entomological research institutes, among which an important place is occupied by laboratories and institutes for the study and utilization of entomophages for biological control purposes. This is all the more remarkable since in Europe almost no natural biocenoses have been preserved and chemical pest control would seem to be the only possible method.

However, entomophages can not always be used nor can they be used against all pests and the effect of their utilization is delayed under the best of circumstances, while the main objection is that the problems of using entomophages are immeasurably more complicated than the application of chemical poisons. The utilization of entomophages is a problem in the directional modification of biocenoses; it is unusually complicated as a rule and requires diversified information on systematics, biology, biocenotic relationships, distribution, and similar infor-

mation which is usually unavailable. This in particular has brought about the hitherto limited application of the biological method as opposed to the chemical one. All this also explains the increasing interest in entomological literature. To follow the many thousands of articles published every year and scattered in the approximately 2,000 journals, often difficult to obtain, has become a very difficult, and in practice impossible, task.

The book now presented to the attention of the Russian reader is an almost complete translation of the first volume of a collection of papers written by a group of authors, primarily specialists of the USA, England, Canada, and the FRG, which appeared in the USA in 1956. One paper by W. R. Thompson, "Basic theory of the biological method of insect control",* was omitted. The Russian edition contains 20 papers, including the following: two on systematics, four on biology, ecology, and physiology, 12 on agricultural entomology in the broad sense (including one each on soil entomology, quarantine, repellents, and apiculture), six on the chemistry of insecticides and their action on insects and their biocenoses, and two on veterinary and medical entomology. There is no evident order in the arrangement of subject matter among the papers in the collection. After the foreword the collection opens with a paper on the physiology and biochemistry of diapause, which is then followed by papers on systematics, ecology, and biology interspersed with papers on insecticides and unconnected aspects of agricultural entomology. This situation, together with the condensed, synoptic, and occasionally abstracting nature of the papers in the collection, does not allow us to present any sort of complete and coherent survey of all the papers; this, furthermore, requires that the review be of considerable length. We might mention here that the papers on insecticides were summarized in the extensive and thorough foreword by the editor of the collection, B. I. Rukavishnikov (pp. 5–19).

We will primarily discuss the articles on systematics, biology, and ecology.

Of greatest interest to systematists is the paper by T. H. Hubbell (Michigan, USA) on certain aspects of the geographical variation of insects. Essentially this is a paper on population systematics, which are now, as the author asserts, one of the central themes of the so-called new, or gamma, systematics. As is well known, in the "brief and useful system for designating the three levels of systematics" (p. 88) alpha-systematics is the description of species, beta-systematics the hierarchical classification of species and subspecies, and gamma-systematics the systematics of populations, which study differences and evolution within species limits. Insect systematics throughout the world are basically a mixture of alpha- and beta-systematics, the level of knowledge having reached that of gamma-systematics only in a few individual groups and complexes of species, among which the highest position is occupied by Drosophila alone. The author himself has worked in the field of population systematics, hence the subject, method, and results of investigations offer special interest in his paper. Above all, the author points out that after becoming aware of the enormous, but hidden complexity of "uniform" populations of Drosophila and several of the better studied Orthoptera and other insects, "it must be considered highly probable that 'uniform' populations exist only as inventions of the systematists" (p. 97). In genetic composition the hierarchy of populations within a species must include a very large number of levels, whereas the number of levels distinguished by morphological characters is insignificant and depends on the specific characters and methods of study. The author considers the basic criterion of the species to be that of reproductive isolation, in agreement with presently widespread opinion. The study of species in the new systematics is primarily an ecological and geographic investigation of populations with consideration of questions of genetics, cytology, and physiology. Methods include the biometric study of samples of the natural population, statistical and mathematical treatment of measurements, graphic methods, and analysis of dispersions. In practice all these laborious methods are preceded by an analysis of series through inspection and visual estimation. This method does not replace mathematical treatment, but in the hands of the "experienced and judicious" systematist it can provide results of which the subsequent biometric study would serve merely as confirmation. The subject matter and theory of investigation of geographical variation in populations are characterized by the following examples of topics and terminology: local differentiation; ecophenotypes—individual modifications arising from the conditions of onto-genesis—and ecogenotypes—results of the historic process of natural selection; clinal variation. The term "cline" is proposed to designate the gradual and uninterrupted variation in one character in a geographical or ecological transect; today this designation is often enlarged to include concordant clinal variation in several characters or, even further, to designate a series of merging populations through which a clinal gradient runs ("population clines"). "Ordinary" and "stepped" clines are distinguished. Further terms are: allopatrically and sympatrically distributed species and infraspecific entities; reproductive isolation and hybridization of species and infraspecific entities; typostrophic variation—rapid transformations of populations at the edges of the range in isolated and border populations; gradations—regional variations within the confines of a population consisting of a sum of clinal and other geographical variation; intergradations—the mixed character of a population as a result of hybridization. One distinguishes primary intergradations—between allopatric, genetically distinct populations of one species—and secondary intergradations—occurring between different species as a result of the

* Original title: "The fundamental theory of natural and biological control" - publisher.

breakdown of reproductive isolation between them. "Mosaic-discordant intergradation" is the presence at the border between stable major populations of many very small local populations differing from the larger ones by intermediate characters. The author presents interesting examples of geographical variation in grasshopper populations. He studied micropopulations of Melanoplus puer Scudd. and other species of grasshoppers in more than 100 localities of Florida and discovered homogeneous and stepped clines, allopatric discontinuity, different forms of intergradations and established infraspecific taxonomic groups at five different hierarchical levels. The author considers it necessary to describe as many levels as the material and methods enable one to distinguish, but that only subspecies should be given Latin names, in order not to clutter up the nomenclature. Of particular significance, on the background of all these examples and unfamiliar terminology, are several practical proposals, arising as a result of "general agreement" and presented as conclusions to the paper. These proposals, already put forth in 1940 in the "New Systematics" are: confining oneself to a morphological basis, making use of broader categories where possible, adopting Latin only for species and subspecies, not distinguishing subspecies in uninterrupted gradations, distinguishing species and superspecies (in the absence of intergradation), being guided by convenience and simplicity, and displaying caution in evolutionary interpretations.

The paper of R. L. Usinger, preceding the one just examined, concerns the origin of the binomial system, the reasons for changes in names, and the history of the formulation and development of the "Rules"; the conclusion introduces some very important excerpts from these "Rules", published in 1957 and affirmed by the XVth congress of zoologists in 1958, which were unavailable in Russian translation are still unavailable for practical purposes to the rank and file systematist. The author compares the position of the systematist to a situation "where the driver of a car, driving about a city, is not familiar with the rules of street traffic in force. Soon, to his chagrin, he will be persuaded that ignorance does not remain unpunished". The importance of unfamiliarity with the "Rules" is not limited to the chagrin of individuals but is pressing for a longer time, since it may "in itself bring to nothing the whole colossal labor of two centuries" (p. 85). The conclusion arises that it is essential to translate the "Rules" into Russian and publish them in a sufficiently large edition at an attainable price.

Of exceptional interest, and not only to the entomologist, is the paper by K. Frisch and M. Lindauer on "Language and orientation in the honey bee". The Russian reader is already familiar with the interesting results of the investigations of Frisch on this subject from his book "Bees, their Vision, Smell, Taste, and Language" published in 1955. The present paper presents a survey of subsequent observations made from 1950 to 1955. The "language" of bees is their rhythmic movements and odors obtained from flowers. It appears that bees are able, with the help of a certain dance of circular, wagging, or other movements, to convey fairly accurate information to other bees on the direction and distance of food from the hive. The direction is given in relation to the position of the sun. The angle to the sun is translated on the combs into the angle to the direction of gravity. Thus the bees are capable of determining the location of the sun even during complete overcasts, when man cannot do this with his vision. Experiments with light filters showed that the bees orient by ultraviolet light of wavelengths of 3,000–4,000 Å. Furthermore, the bees are capable of determining direction according to the polarization of light when the sun is obscured by forest or mountains, or if there is even a small section of sky free of clouds. If the way to the food source runs up hill or down hill, or if a contrary or favorable wind is blowing, the bees are able to make the corresponding corrections. Thus the signal is conveyed rather on the basis of the necessary amount of energy expended than on the distance in meters. During the swarming period scout bees appear, having been recruited from gatherer bees of the old brood which had changed their function toward this time. The dance of the scouts on the detached swarm cluster has been studied and is so expressive that the observer is in a position to determine the direction and distance away of the spot chosen for settling. On three occasions the observers located the settlement site, as indicated by the dance of the scout bees, and appeared there even before the arrival of the swarm. Since different scouts find future shelters in different places and bring back different information, a "debate" ensues. The scouts which have found an especially favorable spot dance somewhat longer and more energetically. The scouts which have found inferior places change their prompting movements and join the more fortunate ones. The bees of the swarm, repeating the movements after the dancers, abandon the cluster and fly to the site indicated by the dance.

The paper by A. D. Lees on the physiology and biochemistry of diapause presents the latest data on the inducers of diapause and the factors terminating it. It appears that for insects with facultative diapause, by far the most common factor is reaction to day length. In the majority of species an 8–12-hour day induces diapause; uninterrupted illumination, as well as continuous darkness, blocks diapause and often leads to uninterrupted development. The determining influence may be both the light and dark phases of the light cycle. In this subject particular attention was paid to the works of Russian investigators. It has been determined that diapause in parasitic insects is often induced or, conversely, interrupted and that development is stimulated by some substances in the body of the host. The larvae of the parasite, on emergence, do not develop until a certain stage of phase of development and growth of the host has been reached—the full-grown larva or pupa. Sometimes diapause in the parasite sets in at the time of death of the host. Such ar-

rests in development appear to be beneficial to the parasite, ensuring correspondence with the body dimensions of the host or the necessary synchronization with the timing of the developmental cycle. Conversely, the developmental cycle and, especially, diapause in the host may become modified under parasitic infestation. In this case the modification is also usually favorable to the survival of the parasite. Participation of the endocrine system in the appearance and termination of diapause is highly probable, but concrete examples of the mechanism involved, the biochemical relation to metabolism, and the role of the nervous system are still being disputed.

The survey of H. Lipke and G. Fraenkel on insect nutrition summarizes the data from the enormous number of works (269 in the literature cited) which has appeared in the five years from 1951 to 1955 from the point of view, on the one hand, of the mode of action of insecticides and, on the other, of the adoption of insects for various purposes, in particular for biological control. The requirements of insects in individual food components are examined (in amino acids, proteins, carbohydrates, vitamins, and sterols), as determined by tests with various synthetic media. The same ten amino acids are needed for insect development as are essential for the rat. Of the vitamins, those of the B-group are particularly essential. Rats suffering from an insufficiency of vitamins of this group are free of lice. Yeasts are therefore essential components of synthetic media. All insects studied, without exception, required sterols. Experimental investigations on the symbiosis of insects with microorganisms are rapidly expanding. The latter are essential factors in growth and development, being sources of enzymes, vitamins, sterols, nitrogen fixatives, and glycolytic agents.

The survey of S. A. Graham on the ecology of forest insects encompasses the literature published between 1952 and the beginning of 1955. The interrelationships among insects and their ties to plants and other components of the biocenose are principally discussed. Particular attention is paid to outbreaks of various species and their causes. It has been possible to estimate past as well as current outbreaks of several pests by the annual rings of trees. The role of climatic and weather factors, intraspecies relationships, migrations, and hybridization is examined. The theory is advanced that in certain instances outbreaks of forest insects may be brought to an end as a result of close inbreeding. There is an increase of interest in the problem of regulating insect numbers through silvicultural practices. Cytological and genetic investigations of recent years have led to the morphological delineation of certain "biological" species. Thus, Agrilus liragus was separated from A. anxius Gory on the initial basis of cytological studies and biological characteristics; morphological distinctions were later discovered. Works on parasites and predators of pests are particularly numerous. The author limits himself to selections on certain questions: on the importance of the time factor, on the increase and decrease of effectiveness of parasites, on the importance of synchronization, of competition, spatial distribution, and so forth. A conclusion on birds is interesting: that during light forest infestation birds are of greater benefit than during heavy infestation. The application of viruses for the destruction of insects promises soon to emerge from the experimental stage. Concrete indications have appeared on the physiological causes leading to susceptibility of individual plants to insect attack.

Veterinary and medical acarology are discussed in a survey by H. Fuller. The author is concerned primarily with ixodid and other ticks and mites parasitizing vertebrates. The complexity of the Ornithodoros problem and the spirochetoses caused by these vectors has led to the partial impossibility of distinguishing the biological "species" of "Borrelia" by morphological characters. The existence of specific relationships between individual species of Ornithodoros and the species of spirochets transmitted by them has been established. Considerable success has been obtained in the study of the etiological agent of Rocky Mountain spotted fever and its vectors—ixodid ticks. It was shown that the virulence of the rickettsia may be determined by interference (simultaneous infection) of different strains in mammals. On tick-borne hemorrhagic fevers the works of Russian investigators were taken into account.

Of the six papers on insecticides—"Arthropod resistance to chemicals", "The mode of action of insecticides", "The chemistry of insecticides", "Persisting insecticide residues in plant materials", "Apparatus for application of insecticides", and "Effect of pesticides on the balance of arthropod populations"—we will consider only the contents of the last. The author, W. E. Ripper, works for the "Fisons" pest control company. Two types of disturbances in populations may be distinguished as a result of insecticide action: 1) "short-term" disturbances —"resurgent outbreaks" soon after chemical treatment during one vegetation period and 2) "long-term" disturbances, which are observed after many years. A culmination of this sort of disturbance may be the appearance of forms of insects resistant to the pesticide. "Flare-backs" (resurgent outbreaks) after application of chlorinated hydrocarbons (DDT, BHC, etc.), parathion, para-oxon, sulphur, lime sulphur, copper carbonate, calcium arsenate, derris, zinc sulphate, thiuram and several others, are recorded in temperate, sub-tropical, and tropical climates in orchard and field cultivations for more than 50 species of phytophagagous arthropods belonging to the families of spider-mites and four-legged mites, coccids, aphids, aleyrodid, cicadellids, noctuids, tortricids and olethreutids, trypetids, agromyzids, and even Collembola. The paper includes complete lists of insects displaying "flare-backs" after the application of various pesticides and also tables of species of predators and parasites of insects on which we know the effect of about 25—30 insecticides, when these are applied against their phytophagous prey or hosts. "Flare-backs" are explained by factors in three categories: 1) reduction in numbers of the natural enemies through

the effect of the poison on the pest; 2) the stimulating influence of pesticides on phytophagous arthropods; 3) elimination of competing species. A distinction is made between "flare-backs" of those pests against which the treatment was directed, and outbreaks of other phytophagous arthropods which, up to the time of the treatment, were present in insignificant numbers. Much evidence has been obtained on the connection between the application of insecticides and the reproduction of pests as a result of the destruction of their natural enemies. This consists of a negative correlation between the numbers of the pests and of their natural enemies and of facts attesting to a high degree of effectiveness of entomophages. In addition, relative differences in the toxicity of insecticides to the pest and to the parasite have been shown to exist. Sometimes the toxicity is the same for both partners, sometimes it is lower for the parasite, sometimes higher for the superparasite. The relationship may change depending on the concentration or time of application of the insecticide. It has been shown that there is a possibility of stimulating the reproduction of the phytophagous arthropod and lowering the resistance of the plant to the pest. Fertilization, methods of soil cultivation, etc. may influence the population density of various components of the ecosystem in fields with exactly the same chemical treatment. A stimulation of fertility and an increase in biotic potential via the plant have been observed in the spider mites. All these conclusions are illustrated by many concrete examples. The conclusions are not only based on observations on the consequences of normal protective treatment of orchards and fields, but also on special experiments with previously accurately estimated situations. On the formation of arthropod strains resistant to chemicals something has already been said at the beginning of this review. Resistant forms arise everywhere and against all chemical poisons which are used systematically enough and long enough.

Because of a lack of space we cannot consider the following papers at all here: "Repellents", "Soil insects and their control", "Stored product pests", "Some recent advances in apicultural research", "Insect transmission of plant viruses", "Nonbiting flies and disease", and "Modern quarantine problems". These are all written by specialists in their fields and briefly set forth the latest advances in the given areas of science.

A common fault of nearly all the surveys is an insufficient utilization of the Russian literature. Of particular value to the Russian reader are the bibliographies presented at the end of each survey containing the latest foreign works.

On the whole the book is of great interest to the specialist in entomology and plant protection. A large circle of agricultural specialists (agronomists, silviculturists, selectionists, apiculturists, veterinarians, and epidemiologists) and instructors in the biological disciplines in colleges and universities (geneticists, virologists, physiologists, and biochemists) will find much of use and interest to them in this book, which can be easily augmented thanks to the literature citations.

We welcome the appearance in Russian of this interesting and useful book.

I. A. Rubtsov.

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A. I. Radkevich. "Contribution to the Study of the Entomofauna of the BSSR. Dragonflies of the Northeastern Part of the Byelorussian SSR (Odonata)". Uch. zap. Vitebsk. gos. ped. inst. 6, 71-86 (1957).

According to the author, this paper is the result of the processing of material collected over the course of about 30 years in the northeastern part of the Byelorussian SSR. For this reason, and also considering the title of the paper, the reader has the right to expect a thorough piece of work throwing light not only on the specific composition of the fauna, but also on the distributional features of dragonflies in the territory, their dispersal by biotope, the quantitative relationships between species, their phenology, etc., and all the more so since the author himself correctly emphasizes the fact that in faunal studies "it is essential to remember the direct relationship which exists between the species and their surrounding environment".

Unfortunately, these words of the author were not realized. The work does not contain any data whatever to demonstrate the dependence of the species of dragonflies and their distribution on the natural conditions of the region; furthermore, the paper does not even contain any ecological characterization of the region itself. The quantitative characteristics of individual species are not given and consequently it is not clear which species are abundant and which are rare in northeastern Byelorussia. It is particularly annoying that there are no details on such species as Coenagrion concinnum Joh. and C. ornatum Selys which are undoubtedly rare in the BSSR and the distributional limits of which evidently pass through the BSSR.

Thus, the list of 43 species of dragonflies presented, devoid of any sort of geographical or, in most cases, even original ecological data, is strongly reminiscent of the faunistic works of the beginning of the last century. Some positive aspects of the list are that body dimensions are given (although without any indication of variation) and an attempt is made to give Russian names to all species.

At the beginning of the paper a comparatively broad, general survey of dragonfly ecology and biology is given. Since there is little original material in it it could have been greatly shortened.

The work contains a number of incorrect assertions, errors, and vague spots which show that the author is inadequately acquainted with the subject. In the literature review the author omitted a fundamental and at the same time comprehensive work on Byelorussian dragonflies, that of V. Vnukovskii, published as far back as 1937 in Riga (Festschr. 60. Geburtstage Prof. Dr. Embrik Strand, III), in which 48 species are recorded. There are incorrect figures on the numbers of species, that is, the degree of information available, for the Latvian SSR (44 species) and the German Democratic Republic (46 species); for the former, 51 species were already known in 1951 (Ēntom. obozr. XXXI, 3—4) and for the latter, more than 60 species are known (in Brandenburg alone no less than 58 species have been found: Deutsche Entom. Zeitschr. I, 1—2, 1954).

More than doubtful is the assertion, made three times, that the Anisoptera feed on caterpillars of Phytometra gamma L. and Antheraea pernyi Guér. (pp. 76—77) and larvae of Diprion pini L. (p. 82). As is well known, the functional morphology of these dragonflies enable them to capture only flying prey, and only that flying above them besides. Hence it is our opinion that the destruction of caterpillars by dragonflies is out of the question. It could only be a case of destruction of the moths themselves. In any case, if the author still wants to insist on the correctness of his observations he should describe them in greater detail, since they contradict everything that has been known so far. There is scarcely much sense in the recommendation that dragonflies be driven away from bee hives "by gunshot".

The ecological relationships of larvae with watercourses are sometimes incorrectly stated. Completely incomprehensible is the assertation that larvae of Cordulia, Libellula depressa L., and others "are indifferent to the type of watercourse" (p. 84). That this "indifference" does not occur in nature is shown by the fact that the larvae of these species, as of all others, are found in varying numbers in different types of watercourses. The habitats of the larvae of Coenagrion pulchellum v. d. Lind. and Brachytron pratense Mull. are quite incorrectly described. The first species cannot under any circumstances be assigned to the rheophiles; in Latvia it is found in stagnant or slowly flowing waters and it is hard to believe that this could be any different in Byelorussia; the second species is found in both standing and slowly flowing waters. Moreover, the author confused various damselflies in the nomenclature (see pp. 73, 78, and 80 Calopteryx, Coenagrion, Agrion).

On page 73 he writes: "In the third [species] the males possess special, so-called anal, appendages". Are there really dragonflies without anal appendages? Why does the author assert that there are only five moults in dragonfly larvae? In fact there are considerably more. And does adult flight really occur only at the end of May and beginning of June (p. 74)?

It must be regretted that the author introduced into the scientific literature, without any reservations, an old magazine article on the mass flight of dragonflies in 1868. The fact is that the determination of the dragonflies in this case was patently incorrect: Sympetrum vulgatum L. is a typical autumn species and its appearance en masse by the end of May is improbable.

It must be stated that this well-conceived work is unfortunately very unsuccessful in its accomplishment. The paper was written carelessly, without an adequate knowledge of the topic, and apparently without being edited, thus minimizing whatever positive aspects it had.

Z. D. Spurus.

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Acta Hymenopterologica, Vol. I, No. 1. Fukuoka, 1958, pp. 1— 93.

This new journal, as the very short notice on the cover of the first issue states, will come out once or twice a year at unspecified intervals and will primarily publish papers written on the suggestion of the editor. The editor of the journal is Prof. Keizo Yazumatsu, head of the entomological laboratory of the agronomy faculty at the University of Kiushu in Fukuoka, one of the more prominent and active entomologists of Japan. Prof. K. Yazumatsu is well known through his numerous papers on both the systematics and biology of different groups of Hymenoptera, as well as on problems of biological pest control.

We may then presume that the new journal will devote attention not only to the systematics and biology of Hymenoptera but also to various practical and theoretical problems, such as the theoretical basis of biological pest control and problems of plant pollination.

We may judge on this partly from the contents of the first issue of the journal, since it does not contain any sort of separate foreword on the aims, tasks, or trends of the journal. The reviewer has learned by word from Prof. Yazumatsu that it is proposed to impart gradually an international character to the journal, and the first issue is probably a sample. At any rate, the first issue contains only papers written in English, there is not a single word-character in it, and the Latin title of the journal deliberately emphasizes its international character. It is probable that the financial side of the enterprise has not yet

been clarified, since the notice of subscription (which is taken by the R. Ishikawa Press in Tokyo) is not accompanied by any price figure.

The first issue contains six works and opens with a comprehensive survey of New Zealand ants (by William L. Brown). The author records 23 species, of which only 10 (or 43.5%) are regarded as endemic; of the remaining 13 (56.5%) eight were undoubtedly introduced by man and six more presumably without the help of man. Of these, six were introduced from Australia, one from East Asia, two from Africa, and three from Asia or Africa. Furthermore, in New Zealand ports, 20 additional species of ants have been "intercepted" (from Australia, South Asia, and North America). The ant fauna of New Zealand is unusually poor, even in comparison with that of less extensive islands like New Caledonia and Fiji. It is also interesting that in the ant species of New Zealand (with the exception of two) there is none of the intraspecific radiation so characteristic of the other island faunas, including those of New Caledonia and Fiji.

A note by C. Watanabe is devoted to a description of a new genus of braconids Batothecoides, established on the basis of the Japanese species Batotheca yakashimensis Wat., previously described by the author.

In a paper by H. Ando and M. Okada the embryonic development of the saw fly Aglaostigma occipitosa (Malaise) is described. The authors stated their purposes as: the description of the embryonic development of this saw fly as a representative of the Symphyta, the comparison of the embryonic development of the two suborders of Hymenoptera, and the comparison of the embryonic development of Symphyta and Lepidoptera, the larval phases of which are very similar. It was confirmed that the embryonic development of Symphyta is more reminiscent of that of the Lepidoptera than of the Apocrita (in the sclerotization of the embryonic head, the development of the homologous paired abdominal appendages, and in the chewing mouthparts); there was a greater difference, however, in the processes of blastokinesis and in the laying down of the dorsal organ.

The paper by K. Iwata is concerned with the eggs of Japanese species of ichneumon wasps and summarizes ten years of investigation through dissection. It presents a list of 233 species of Ichneumonidae, measurements and illustrations of the eggs of these species, data on dissection, collecting localities, and in four short sections, summaries of information on subfamilies and on intraspecific variability of eggs and characteristics of their pigmentation.

The last work, by T. Hidano, a colleague of Prof. Yazumatsu, concerns biological observations on Telenomus gifuensis Ashm., a parasite of the eggs of the bug Scotinophara lurida Burm. in Japan. Descriptions are presented of the egg, all larval instars, the pupa, and the adult, the seasonal development of the parasite and its host, the duration of the life cycle, the twenty-four hour cycle, parthenogenesis and the number of eggs laid by one female, relationships between the sexes, methods of oviposition, and also the effect of infestation on various stages of the embryonic development of the host, and its practical control; the utilization prospects of the egg parasite are assessed.

Thus, the contents of the first, technically well-produced issue are diverse enough both as to the groups of Hymenoptera treated and the problems discussed. The representatives of this extensive order of insects are so diverse morphologically and biologically, they display such striking instincts, are of such practical importance, and present such exceptional material for the working out of many important biological problems, that the appearance of a separate journal devoted to a comprehensive approach to them is not only well founded, but very opportune.

V. V. Popov.

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International Symposium on Noxious Synanthropic Diptera. Zeitschr. angew. Zoologie, 46 Jahrgang, Drittes Heft, pp. 323-400, 1959.

The collection of reviews contains 19 reports, extremely varied in size, on the papers read at the above-mentioned international symposium. Unfortunately the reports on the most essential separately published papers are particularly brief.

The symposium met on April 23–25, 1959 in Berlin-Dalem (Institute of Water, Soil, and Air Sanitation). Taking part were 115 delegates, predominantly from the Federated German Republic.

The papers concerned syanthropic Diptera in the broad sense, i. e., on one hand, house flies and other flies more or less intimately connected with man, on the other hand flies accompanying predominantly domesticated animals (Calliphoridae, gadflies, and others), and also living in a more or less close neighborhood with man and breeding in stored food products, etc.

The sequence of accounts in this review lacks the order of arrangement of the papers in the collection.

D. Povolný (Czechoslovakia) – "A point of view in the classification of synanthropic Diptera".

Under consideration is not a taxonomic, but an ecological classification. It is based on a synthesis of ecological features and epidemiological significance of separate groups of synanthropic Diptera, and should serve

the interest of medical entomologists, microbiologists and hygienists. The author distinguished five groups:

1) synanthropes proper (Musca domestica L., Lucilia sericata Mg., Piophila casei L., Protophormia terraenovae R.-D., Muscina spp., Calliphora spp.), closely tied with man and living in his dwellings;

2) semisynamthropes,—in part the same species, predominantly coprophagous, and flesh flies, but obligatorily encountered in nature;

3) asynanthropes living on synanthropes;

4) synbovines (Synbovine) breeding in the excrement of domesticated or wild ungulates; they may be facultative or temporary parasites or commensals of domesticated animals (Stomoxys calcitrans L., Lyperosis irritans L., Drosophila spp., Musca domestica—populating stalls);

5) inducers of miases.

G. Wellmann (F. G. R.)—"Stable flies as vectors of zoonoses".

Stable flies may be mechanical vectors (through blood-sucking) of dermal Leishmaniosis and sleeping sickness. The possibility of transmission of Trypanosoma gambiense, an agent of leptospirosis and Veil's disease, by stable flies has been confirmed experimentally. Stable flies are carriers of a series of agents of bacterial origin (especially the rods of typhus, paratyphus and enterocolitis). Stable flies play a lesser role in the transmission of tularemia than do gadflies and ticks, but may transmit erysipelas and brucellosis. This has been confirmed with experiments on swine and mice. The significance of stable flies in transmitting a series of virus diseases (yellow fever, hydrophobia) has also been confirmed.

E. Bulling, G. Bakri and E. Kirchberg (F.G.R.)—"Necrophagous Diptera as vectors of Salmonella".

Salmonella typhi murium and S. cottbus were isolated from Lucilia sp., Calliphora sp. and Muscidae sp., collected from refuse of a swine-bristle warehouse. The former of the above species of Salmonella was found on flies from a doss-house near a police station. In addition, S. newington was found in swine manure.

L. Schmidt (Berlin)—"Experimental transmission of disease agents by flies. On negative tests".

In order to determine whether or not flies are transmittors of disease agents, it is necessary to fulfill three conditions in experiments: 1) induce contact of the flies with the reservoir of infection; 2) be certain that the infection begun remains viable in the fly for a determined time; 3) bring about the transmission of infection to a new host. More detailed information of experiments observing these rules is presented in relation to spirochaetes, toxoplasmoses and poliomyelitis.

B. Hörnig (Berlin)—"Flies as vectors of parasitic worms".

Larvae of the filaria Habronema muscae, excreted with the droppings from the intestines of horses, donkeys and zebra, may enter the body of larvae of house flies and a series of other species breeding in their dung, and pass a complicated developmental cycle there, migrate in the body of the host larva, transfer to the adult insect and become localized, toward this time, at the fly's proboscis. During contact of the fly's proboscis with the mucous membrane of the mouth, nose, eyes or with wounds, the filaria may enter the mucous membrane and cause conjunctivae or inflammation in the wounds. H. microstomum develops in an analogous manner in Stomoxys calcitrans L. In Central Asia Parabronema skrjabini is transmitted by Lyperosia exigua de Meij. Various species of Habronema, and also Raillietina tetragona have their own peculiarities of development and migration in the body of all those same vectors—synanthropic flies. Gadflies are vectors of the human filaria, Loa loa.

G. Bakri (Berlin-Dalem)—"Flies of the Musca domestica vicina and sorbens complex, diagnostic features, life history, and their medical significance in Egypt".

In Egypt M. domestica vicina Macq. is a carrier of typhoid rods and agents of conjunctiva, and M. sorbens Wd. is chiefly a carrier of conjunctiva. The former breeds in the dung of domesticated animals, the latter exclusively in human feces. A system of control measures against these flies is presented, in which chemical control measures are of fundamental significance. However, they do not achieve their aim without the observance of extended sanitation programs.

B. B. Rodendorf (Moscow)—"Species of sarcophages in the faunistic complex of synanthropic Diptera of various landscape zones in the USSR".

The author distinguishes the following ecological groups of sarcophages and their corresponding life forms:

1) coprophages [for example, Belliera melanura (Meig.), Coprosarcophaga haemorrhoidalis (Fall.), Ravinia striata (Fabr.)];

2) necrophages (Schyzophaga), living in corpses of vertebrates and insects, in meat and other decomposing organic material [Parasarcophaga tuberosa (Pand.)];

3) predators, chiefly on insect pupae [P. pseudoscoparia (Kram.), Kramerea schutzei];

4) parasites (in insects and in wounds of vertebrates; example—Blaesoxipha spp.).

Given are the characteristics of the faunistic complexes of sarcophages in the European and Siberian Taiga, in steppes, in landlocked seas (Krym—Caucasus), in deserts, Central Asian mountains and in the Far East.

H. Peters (Heidelberg) – "Stomoxys – an interesting component of the synanthropic dipterous fauna".

An analysis of the population dynamics of Stomoxys and Musca in stables, cow barns and pigsties. Characteristics of biotopes preferred by Musca and Stomoxys (species are not stated in the report).

D. Teschner (Braunschweig) – "Houseflies on feces in cities".

The author conducted regular counts of Diptera on feces from May to November, 1958. Around 3000 individuals were collected during that time. Of the 15 species found, the most common were: Musca domestica L. –60.4%, Drosophila funebris (Fabr.)–14.8%, Culex pipiens L.–7.9%, Fannia canicularis–4.7%, Muscina stabulans (Fall.)–2.9%, Calliphora erythrocephala (Mg.)–2.8%. Among others relegated to last place were Caenia palustris (Fall.) Tipula sp., Onesia sepulchralis (Mg.), Megaselia sp., Calliphora vomitoria (L.), Fannia scalaris (Fabr.). Material from other districts indicates significant variation in species compositon and numbers of coprophagous flies. Also in Braunschweig, according to other observations, the first place in the fecal fauna was taken by Hydrotaea dentipes (Fabr.), Fannia scalaris (Fabr.), F. manicata (Mg.), F. canicularis L., Scatopse notata (L.) and others.

E. Kirchberg (Berlin-Dalem) – "Comparative studies of Diptera frequenting various habitats containing squirrels".

Quantitative counts of synanthropic flies in the course of four days on different baits (human feces, rat cadaver, dung of swine, cows and horses) in sunshine and in shade showed that the frequency (except for the rat cadaver) in the sunshine declined from the first to the fourth day, but in the shade a maximum occurred during the second day on the rat cadaver and on the human feces. The comparative frequency of different species in these habitats vary noticeably in the shade and in the sun, but the first two substrates are preferred by all the synanthropic flies.

R. R. Kühl (Hameln) – "Status of the dermal gadfly problem in Germany".

A law concerning gadfly control has existed in Germany for around 25 years. However, a discussion of the success of measures taken is presented by the author. The number affected in the gadfly areas increased by comparison with 1908. The reasons are connected with war conditions (insufficiency of drugs, personnel, loss of interest, "invisibility" of the larvae for a large expanse of the developmental cycle and the near invisibility of the adult, etc.). Systematic applications of larvicides significantly decrease the dermal gadfly populations. Losses from gadflies in Germany are still appraised at a sum of around 40–50 million marks (of that number 6–8 million marks are accounted for by damage to skins and 40–50 million marks by suppression of growth, loss of meat and milk yield). Fresh data were presented briefly on the biology of the gadflies; on the cycles and duration of development of different stages, fecundity, growth, migration in the host's body, experiments in control. Results of the experiments and directions for controlling stomach gadflies by means of intestinal rinses with a special probe, are presented.

O. Gebauer (Austria) – "On experiments in dermal gadfly control conducted in Austria".

Presented are the results of tests with organic phosphorous preparations for exterminating larvae, and indications and contraindications for application of the insecticide.

D. J. Kuhenen (Netherlands) – "Experiments with individual and mass rearings of Musca domestica".

The influences of nutritional media on larvae, and of temperature and larval density on fly emergence were investigated. The following feeding mixture is recommended: 200 g cellulose, 250 g powdered milk, 12 g yeast and 1000 g water. Significant variation is noted in the development of populations and fly emergence under the same conditions, depending on the characteristics of the initial parental individual or population.

K. Mayer (Berlin – Dalem) – "Changes in behavior in Diptera. Analysis of its functions and its significance for applied entomology".

A synopsis of previous investigations on the ability of flies to distinguish light, odor, taste and temperature, on the appearance of food "performance" in a series of generations, on effects of insecticides on the basic functions. Data from these observations and experiments is extremely valuable in the development of chemical and biological control measures (addition of attractive substances to insecticides, concentrations of entomophages in required places, etc.). A series of changes are noted by the author in the behavior of parasites (Pales pavida Mg. and Blondelia nigripes Fln.) consisting mainly in changes in degree of preference and infection of various hosts, which is physiologically connected with the natural selection of constitutionally different lines in mixed populations. A broadening of the range of hosts, leading to the appearance of polyphages, is explained by the origination and fixation of new food "preferences" (Hopkins principle).

H. Schuman (Greifswald) – "Systematics of the larvae of synanthropic and synbovine flies".

In the opinion of the author the larvae of synanthropic flies of the families Calliphoridae, Muscidae, Sepsidae, Borboridae and Cordyluridae, as in other higher Diptera, are morphologically extremely alike. Included is a list of characteristic features used in identifying the

various developmental stages for species, genera and families of syanthropic flies common in Europe.

R. Wieseman (Sweden) – "Differences in physiology between normal and resistant forms of houseflies".

A connection has been established between the resistance of flies to insecticides (DDT and organic phosphorous preparations) and a relatively high (10–20%) lipoid content in the body of the fly. The lipoid content of the thoracic ganglia in resistant flies is higher (by 40%) than in normal flies. An enzyme (dihydrochlorinase) has been discovered that breaks down the DDT in the body of the poisoned fly and inactivates the etheracetylcholinesterase which paralizes the nervous system. The resistance of flies, on the whole, is determined by many factors, and at present the most essential investigations for the solution of these problems are in the area of physiology of behavior and nutrition.

Veronica Bochnig (Berlin) – "On the genetic bases of fly resistance to insecticides".

Resistance of flies is determined by many genes. In some instances "leading" genes for resistance are found. Such a "monogenic" resistant form of Musca was found in Denmark. The frequency of these genes in different populations varies greatly, but selection (for example, in intensive chemical control) leads to a concentration of genes for resistance. In nature these genes are comparatively sparsely dispersed in populations homozygous for resistant genes. However, this process, as all evolutionary processes, proceeds slowly. Acclimatization to DDT, as shown by special experiments with Drosophila, usually does not increase resistance. After acclimatization in the course of 130 generations the Drosophila were still as sensitive to DDT as at the beginning. This has also been established in relation to other toxins (nicotine, arsenic preparations, pyrethrum and others). Numerous works show generally the variegation in hereditary mechanisms eliciting resistance to insecticides.

H. Kükental (Leverkusen) – "Control of extermination of flies".

An argumentative position that it is better to prevent fly increases than to control them after their appearance.

I. Keiding (Denmark) – "Control of flies and development of resistance (of flies) to insecticides in Denmark".

Immunity to DDT in houseflies in Denmark developed after five years (1945–1950) of systematic application of the insecticide. In 1952 DDT was substituted for parathion and diazonone, in 1955 these were replaced by resitox, in 1957 by dipterex, and in 1958 malathion was put into use. A high resistance developed to resitox and diazonone, and weak resistance to parathion, dipterex and malathion. In the five to eight years that the use of DDT and diazonone was discontinued, resistance to them decreased greatly, but the genes for resistance were preserved and are found in almost any populated locality. Application of these toxins for controlling flies is hopeless.

I. A. Rubtsov.

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Günter Olberg. Behavior of Solitary Wasps of Central Europe (Vespidae, Pompilidae, Sphecidae). Berlin, 1959, 402 pp. with 779 Figures.

The work reviewed represents investigations into the biology of the families Vespidae, Pompilidae (Psammocharidae) and Sphecidae. A large portion of the book is based on original observations conducted on more than 40 species of the above-named group of stinging hymenopterans. The work is filled with new data on the behavior of these insects, which was made possible, to a great extent, by new methods in research. The author made wide use of the camera, which permitted him to observe many subtle aspects of wasp behavior which the human eye is not in the position to capture. The presentation of photographs in the book is of great value in supporting earlier data from visual observations. The book is particularly richly illustrated and written in a sufficiently popular style. There is no doubt that not only specialists, but the entire broad circle of arm-chair zoologists should explore it with interest.

The work consists of two parts–general and specialized. In the general part, a brief discussion concerns generic relationships of Vespidae, Pompilidae and Sphecidae, biotopes inhabited by the species belonging to these families, and their phenology, presenting information on flowers visited by them, enemies (chiefly parasites) and basic details of behavior. In the specialized part, behavior of separate species is described. In the specialized as well as in the general part, the author does not restrict himself to a simple description of wasp behavior, and in many instances analyzes it from the point of view of evolution of the groups and their coenotic relationships.

We shall linger briefly on some information and ideas, produced by the author, which are most interesting. The work broadly illuminates the question of feeding by the wasps on flowers and secretions of aphids and Homoptera. The overwhelming majority of wasps are not specialized and may feed on a very large range of flowers, usually with open nectaries. Those species which feed on flowers are very reluctant to transfer to feeding on secretions of aphids and Homoptera. The species of Vespa and

Melinus, on the contrary, are rarely encountered on flowers, but visit aphid colonies in masses. In general, forms feeding on Homoptera secretions are more primitive in the structure of the mouth parts. Species with projecting mouth parts are more specialized (Ammophila, Sphex, Podalonia) and may feed on closed flowers such as clover.

Many particularly interesting observations were made on the nesting of the wasps. The number of species, whose nests the author was able to observe, is remarkable. It was here, during investigations into the manner of nest-building and delivery of prey, that especially many subtle observations were conducted with the aid of camera. Wasps building nests independently are divided by the author into miners, gnawing passages in the heart of stems or in clay, "diggers", digging nests in loose soil, in which, as a rule, the anterior legs serve as digging instruments, and "masons", which construct partitioned, single-celled chambers from clay (Eumenes, Pseudagenia, Sceliphron). Diggers are separated into three types: pompiloid, when the wasp's legs work alternately, specoid, in which both anterior legs move synchronously, and apidoid. In the first two types the middle and posterior legs are spread widely and do not take part in digging; in the last type, on the contrary, the dug soil is scraped away with the aid of the middle and hind legs. The apidoid type is mainly characteristic for solitary bees and some short-legged wasps (Mellinus, Cerceris).

Material dug from the depths of passages is also removed by several means. "Digging wasps" toss sand particles and lumps of soil far back, as may be seen by the way these lumps fly out of the tunnel (pompilids—Pompilus, Episyron, Batazonellus, Anoplius, sphecids—Philanthus, Epibembix). "Running wasps" scrape the excavated material back with the front legs and then push it, moving it out of the passage backwards, and working on the principal of a piston. In such species a pygidial margin is developed at the apex of the abdomen, facilitating the pushing of sand (for example, Cerceris) The pygidial bristles in Anoplius serve the same purpose, just as does the pygidial furrow in bees of the genus Halictus. During the excavation of a nest by this type, a small mound appears around the flight aperture, "Pulling wasps" carry out the lumps of soil, holding them, similarly, with the excavator's front legs and the lower end of the head

| | Sphecidae | Pompilidae | Vespidae |
|---|---|---|---|
| Prey species. | Insects or their larvae; some hunt spiders. | Only spiders. | Caterpillar-like insects. |
| Number of victim specimens in the cell. | This varies, sometimes very significantly; some genera (Podalonia) provide only one victim; there are always several specimens in cells of species providing spiders. | Always only one spider, most often a female. | From several to a large number of specimens. |
| Means of locomotion during transport of prey. | Usually flight; only a heavy prey is conveyed by dragging along the ground. | Almost exclusively by dragging (Pompilus cinctellus Spin. sometimes fly). | Usually flight. |
| Direction of movement during transport of prey. | With head forward. | Many species (most?) with the head backward (moving backward). | With head forward. |
| Means of holding prey during transport. | With the legs, often also with the mandibles, rarely only with mandibles or on the stinger (Oxybelus). | With mandibles only. | With mandibles and legs. |
| Time of nest construction. | Largely before hunting. | Largely after hunting. | Always before hunting. |
| Means of excavating the nest. | Almost always like the sphecoid type. | Always like the pompiloid type. | Few dig; means unknown. |
| Tamping material with the abdomen in plugging the entrance to the nest when digging it in. | Known only in Tachysphex. | Obligatory or facultative in most (all?) species constructing nests in sandy soil. | Unknown. |

(Mellinus of the sphecids and also many solitary bees). "Carrying wasps" hold the lumps of soil with the front legs, the lower end of the head and the mandibles, and carry them away or fly away with them. Ammophila, Podalonia and Pterochilus have well-developed setae on the head and front legs for this purpose.

Many interesting observations were made by the author on various species of wasps at the time they were stinging their prey. Of interest are ideas regarding the part of the victim which the wasps sting: either in the nerve ganglia (a wide-spread view following the well-known classic investigations of Fabre) or else in any point of the body. Siding with the second view, the author explains, in addition, why the victim is usually stung in the lower parts of the body, near the ganglia of the abdominal nerve cord. This is explained by their being protected by the thinnest and weakest covering, as a result of which they are most vulnerable to the sting. However, is not such simplicity of explanation a reflection of his own simplicity? Sufficiently careful observations conducted by many authors on a significant number of wasp species attest that the prey is actually stung in the ganglia. For this reason, the views of the author of the reviewed book, in order to be convincing, should be supported by well-grounded factual material. Interesting data were obtained on the nesting of Ammophila pubescens Curt. This wasp, which is distinguished by caring for its progeny, bringing fresh prey to its larva several times in the course of its developmental period, may simultaneously tend 2–3 nests.

It is impossible to dwell here on all aspects of wasp biology elucidated by the author and illustrated with many photographs. The most general rules of behavior in the solitary wasps of all three families are condensed by the author of the book in the table presented above.

Olberg's work, upon the whole, is interesting and certainly deserves a high evaluation; however, it is not devoid of faults resulting from its original form. It is entirely understandable that the author should strive to emphasize those aspects of wasp biology which may be captured with photography. This probably explains the very small list of literature citations in the book, creating an untrue impression of the extent of studies of wasp biology, and the absence of data on the structural details of underground nests of many species which the author was able to observe. Even though these faults may be justified, in view of the mentioned features of the work, at the same time it is regretable that some aspects of wasp biology remained unelucidated. The author should not be reproached for avoiding the evolutionary approach to the group of insects investigated. On the contrary, a series of questions in the book are actually treated from that aspect. It is the more striking that the author circumvents mention of the works of S. I. Malyshev on the evolution of instincts in wasps. Meanwhile, these works are first of all known for studies of adult wasp behavior and contain an enormous accumulation of material from literature, coming in close contact with the questions touched upon in the reviewed book. Undoubtedly, if the author had approached the investigation of many subtle sides of wasp behavior from the theoretical aspects of S. I. Malyshev, his book might have been even more pithy.

V. I. Tobias

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H. Haupt. "Coleoptera from the Eocene Brown Coal of Geiseltales." Geologica, 1950, 6. Akad. Verlag GMBM, Berlin : 1-168, 113 figs.

H. Haupt. "Material from Studies of Eocene Arthropod Fauna of Geiseltales." Nova Acta Leopoldina, Bd. 8, N 128, N.F., 1956. J. P. Barth (Verlag), Leipzig : 1-90, 106 figs.

Paleontological investigations of tertiary insects are not numerous, despite the evident value of such works. For this reason the large treatise by H. Haupt, on studies of arthropod fragments from the middle eocene brown coal deposits of Geiseltales in Germany, deserves much attention. A total of 130 species are described, among which there are 1 diplopod, 1 phalangid, 5 homopterans (4 genera), 4 cockroaches (3 genera), 1 dragonfly, 1 Mayfly, 1 scorpion-fly, 2 caddis-flies (1 genus) and 110 beetles. Of these species 1 phalangid and 9 beetles belong to present genera, namely: Torgulus (phalangid) Georyssus (1 species), Niptus (2 species), Donacia (5 species), Plateumaris (1 species); 2 genera and 4 species are included with the already known fossil forms, but they are redescribed. The remaining species and genera, among them 45 genera and 106 species of beetles, are described as new.

The immense work accomplished by Haupt significantly surpasses in scope all previous works on tertiary insects and indisputably deserves praise. Unfortunately the scientific value of this work is reduced by some faults.

The material studied consists of insect fragments, sometimes of their impressions, in brown coal. In most instances the forewings were preserved, and in beetles the elytra or their parts, sometimes also the pronotum with or without the head. The venter of the body could be studied in only one instance. Of the legs, sometimes the coxae were preserved; tarsi are described only for the genus Eosagra Haupt. Antennae were almost always lack-

ing, in several instances 2–3 of the first segments were preserved; in Rhinohelaeites longipes Haupt antennae were preserved with 11 segments, but the last ones did not resemble terminal segments. The remnants are usually colored in a bright metallic hue, which is correctly considered by the author as a partly secondary effect, which may be explained by the conditions of burial. Many samples are distinguished by their large size and belong to specimens whose body length exceeds 30 mm. Several remnants give a fairly complete representation of the insects (especially when a series of remnants belongs to the same species), but in most instances the data for the species' characteristics are very inadequate. For this reason it is not surprising that the author's conclusions concerning their systematic position evoke great doubts. Inasmuch as the vast majority of the described species belong to Coleoptera, we shall dwell only on this order in this review.

The first thing that is surprising in Haupt's work is the confidence with which he places one or another species in a particular family. Even if those statements which the author himself considers doubtful be set aside, there still remain very many extremely arbitrary evaluations. Thus Lecanopteryx miranda Hpt. is described from a single elytra with a large oval depression, and placed in the family Cupedidae; however all known contemporary and fossil cupedids possess a very characteristic alveolar construction on the surface of the elytra, totally lacking in this specimen. Eosilphites decoratus Hpt. is placed in Silphidae on the basis of the shape of the head and pronotum, but it does not resemble the contemporary species of this genus, in part, namely, in the structure of these body parts. Eumecoleus tenuis Hpt. (two elytra) is described as an oedemerid (Oedemeridae), even though its elytra lack veins so characteristic for most species in this family, and might have been placed, with no less certainty, in many other families, for example in the Tenelyubam* . Sixteen species are included in the darkling beetle family conditionally, but sometimes mistakenly. In actuality, it is known that the specific construction of the trochanter is characteristic only for darkling beetles and two related families–Lokhmatok* and Alleculidae. For two described genera (Pyrochalcaspis Hpt. and Eodromus Pongr.) the trochanter depicted by Haupt does not at all resemble the trochanter of darkling beetles. Even if it is assumed that Haupt's sketches are distorted–evidently he was unaware of the construction of the trochanger in darkling beetles, and his sketches were meant to show only the construction of the coxae–these species should have been placed not in Tenebrionidae but in Alleculidae, as their genae do not bulge in front of the eyes as is observed in contemporary holarctic darkling beetles and like the genae in alleculids. True, some Ethiopian darkling beetles are known in which the genae do not bulge in front of the eyes, but these forms do not resemble the species described by Haupt, and all authors, among them Haupt, describing tertiary Coleoptera, have noted the absence of systematic connections between tertiary holarctic and contemporary Ethiopian insect faunas. The systematic significance of the presence and arrangement of the trochantin in beetles should be mentioned. Haupt says nothing of them, and his representations of the coxae are so gross that they are not dependable. Be that as it may, his sketches do not show a trochantin, which also attests against placing these species in Tenebrionidae.

The basic reason prompting Haupt to recognize the given species as darkling beetles appears to be the form of the elytral striae. But if one may agree with Haupt that such a system of striae is not characteristic for ground beetles, it then follows that these forms do not belong to Tenebrionidae, as similar arrangements of striae are also observed in other Heteromena–in alleculids or Tenelyubov*.

Finally, of the genera placed by Haupt in Tenebrionidae, at least two, and the two most clearly described, –Pyrochalcas Hpt. and Eodromus Pong.–belong to another family; Caryosoma, judging from the form of the head, is not a darkling beetle. The peculiar genus Paropiophorus Hpt. can hardly be a darkling beetle, as its third antennal segment, judging by the sketch, is shorter than the second, which is not observed in darkling beetles. Phinohelaeites Hpt. probably is a pythid (Pythidae).

As regards the rest of Haupt's "tenebrionids", their real systematic position is hardly determinable. References to the leaf-beetle genera Eochrysomela, Holocoleus, Gonocelis and others, are also arbitrary.

Among the described genera there are those that evoke no doubt concerning placements in families. However, here too, one may be surprised at the systematic relations assumed by the author. Thus the genus Microjulodis Hpt. is placed in the tribe Julodini, which is hardly correct, as the species of this tribe are characterized by a stout, almost cylindrical body, which when compressed (peculiar to all specimens described by Haupt) could never produce the contour depicted in his Figure 27. On the contrary, in the large contemporary genus Sphenoptera, widely distributed in Eurasia and Africa, forms are encountered differing little from Haupt's forms. In addition, the prothoracic furrow in Sphenoptera is usually pronounced, but sometimes worn out, as in the species described by Haupt, and representatives of this genus have already been described from tertiary deposits in Germany.

A list of species were placed by Haupt in the genus Eoanthaxites Hpt. and in the tribe Anthaxiini on the basis of the shape of the pronotum, but these species, according to all criteria stated by Haupt, stand closer to the genus Tropeopeltis of the tribe Sphenopterini.

It follows from the above that Haupt's work, regardless of its quality, should be considered only as the first approach to the study of tertiary insects described by him.

Among these insects there are several very interesting forms. Thus the peculiar genus of leaf beetles, Eosagra

* Transliteration

Hpt. is undoubtedly close to the contemporary Sagra, but differs from it in a series of features very well recorded by the author. There is a remarkable species of elaterid of the genus Eopyrophorus Hpt., which is close to the contemporary luminescent neotropical elaterids of the genus Pyrophorus. Haupt was unable to establish the presence of a luminescent apparatus for the fossil form, but investigations conducted by him with the aid of E. Voigt on the tracheal system of both genera in the zone of the luminescent apparatus in Pyrophorus disclosed the existence in both genera of a homologous and at the same time an extremely unusual tracheal network, attesting to an undoubtedly close genetic relationship of these genera.

Finally, Haupt has made interesting attempts in the analysis of elytral structure in Coleoptera. However, his studies of contemporary material were entirely inadequate for this purpose, and his phylogenetic discussions should have gained much had he been familiar with the work of A. A. Richter (1935). In part, he should have found in this work the correct terminology for the veins of the elytra (Haupt did not discriminate the basic characteristics in venation of Coleoptera elytra, in which the radial vein is always bifurcate). In addition, judging by the bibliography presented, the author is not sufficiently familiar with the literature, domestic and foreign. Thus, especially surprising is the complete absence of references to works on Coleoptera in amber, some works of Zhannelya, etc.

It may also be regretable that the author paid insufficient attention to the proper orthography in naming some new genera. Thus the unfortunately named Telmablatta should have been written Telmatoblatta; however, this name is also unsuitable, as it combines Latin and Greek roots. It is not correct to write Kalophryganidae, which should be written Calophryganida.

In conclusion, we should like to point out that in our opinion a specialist should not consider himself at all obliged to name any fossil fragment, so much the more, to be obliged to ascribe it to a definite systematic position. Attempts to achieve great accuracy in determinations often exceed the available objective possibilities, and the determinations in this instance become guesses. This in no way increases the scientific value of the work and may only confuse the already complex question of studies of fossil insects.

S. M. Yablokov-Khzoryan.

## RUSSIAN JOURNALS FREQUENTLY CITED
### [Biological Sciences]

| Abbreviation* | Journal* | Translation |
|---|---|---|
| Agrobiol. | Agrobiologiya | Agrobiology |
| Akusherstvo i Ginekol. | Akusherstvo i Ginekologiya | Obstetrics and Gynecology |
| Antibiotiki | Antibiotiki | Antibiotics |
| Aptechnoe Delo | Aptechnoe Delo | Pharmaceutical Transactions |
| Arkh. Anat. Gistol. i Émbriol. | Arkhiv Anatomii Gistologii i Émbriologii | Archives of Antomy, Histology, and Embryology |
| Arkh. Biol. Nauk SSSR | Arkhiv Biologicheskikh Nauk SSSR | Archives of Biological Science USSR |
| Arkh. Patol. | Arkhiv Patologii | Archives of Pathology |
| Biofizika | Biofizika | Biophysics |
| Biokhimiya | Biokhimiya | Biochemistry |
| Biokhim. Plodov i Ovoshchei | Biokhimiya Plodov i Ovoshchei | Biochemistry of Fruits and Vegetables |
| Bot. Zhur. | Botanicheskii Zhurnal | Journal of Botany |
| Byull. Éksptl. Biol. i Med. | Byulleten Éksperimentalnoi Biologii i Meditsiny | Bulletin of Experimental Biology and Medicine |
| Byull. Moskov. Obshchestva Ispytatelei Prirody, Otdel Biol. | Byulleten Moskovskogo Obshchestva Ispytatelei Prirody, Otdel Biologicheskii | Bulletin of the Moscow Naturalists Society, Division of Biology |
| Doklady Akad. Nauk SSSR | Doklady Akademii Nauk SSSR | Proceedings of the Academy of Sciences USSR |
| Éksptl. Khirurg. | Éksperimentalnaya Khirurgiya | Experimental Surgery |
| Farmakol. i Toksikol. | Farmakologiya i Toksikologiya | Pharmacology and Toxicology |
| Farmatsiya | Farmatsiya | Pharmacy |
| Fiziol. Rastenii | Fiziologiya Rastenii | Plant Physiology |
| Fiziol. Zhur. SSSR | Fiziologicheskii Zhurnal SSSR im. I. M. Sechenova | I. M. Sechenov Physiology Journal USSR |
| Gigiena i Sanit. | Gigiena i Sanitariya | Hygiene and Sanitation |
| Izvest. Akad. Nauk SSSR, Ser. Biol. | Izvestiya Akademii Nauk SSSR, Seriya Biologicheskaya | Bulletin of the Academy of Sciences USSR, Biology Series |
| Izvest. Tikhookeanskogo N. I. Inst. Rybnogo Khoz. i Okeanog. | Investiya Tikhookeanskogo N. I. Instituta Rybnogo Khozyaistva i Okeanografii | Bulletin of the Pacific Ocean Scientific Institute of Fisheries and Oceanography |
| Khirurgiya | Khirurgiya | Surgery |
| Klin. Med. | Klinicheskaya Meditsina | Clinical Medicine |
| Lab. Delo | Laboratornoe Delo (po Voprosam Meditsiny) | Laboratory Work (on Medical Problems) |
| Med. Parazitol. | Meditsinskaya Parazitologiya i Parazitarnye Bolezni | Medical Parasitology and Parasitic Diseases |
| Med. Radiol. | Meditsinskaya Radiologiya | Medical Radiology |
| Med. Zhur. Ukrain. | Medichnii Zhurnal Ukrainskii | Ukrainian Medical Journal |
| Mikrobiologiya | Mikrobiologiya | Microbiology |
| Mikrobiol. Zhur. | Mikrobiologichnii Zhurnal | Microbiology Journal |
| Nevropatol., Psikhyat. i Psikhogig. | Nevropatologiya, Psikhyatriya i Psikhogigiena | Neuropathology, Psychiatry and Psychohygiene |
| Ortoped., Travmatol. i Protez. | Ortopediya, Travmatologiya i Protezirovanie | Orthopedics, Traumatology and Prosthetics |
| Parazitol. Sbornik | Parazitologicheskii Sbornik | Parasitology Collection |
| Pediatriya | Pediatriya | Pediatrics |
| Pochvovedenie | Pochvovedenie | Soil Science |
| Priroda | Priroda | Nature |
| Problemy Éndokrinol. i Gormonoterap. | Problemy Endokrinologii i Gormonoterapii | Problems of Endocrinology and Hormone Therapy |
| Problemy Gematol. | Problemy Gematologii i Perelivaniya Krovi | Problems of Hematology and Blood Transfusion |
| Problemy Tuberk. | Problemy Tuberkuleza | Problems of Tuberculosis |
| Sovet. Med. | Sovetskaya Meditsina | Soviet Medicine |
| Sovet. Vrachebny Zhur. | Sovetskii Vrachebnyi Zhurnal | Soviet Physicians Journal |
| Stomatologiya | Stomatologiya | Stomatology |

*BRITISH-AMERICAN TRANSLITERATION SYSTEM.

(continued)

(continued)

| Abbreviation | Journal | Translation |
|---|---|---|
| Terap. Arkh. | Terapevticheskii Arkhiv | Therapeutic Archives |
| Trudy Gelmint. Lab. | Trudy Gelmintologicheskoi Laboratoriya | Transactions of the Helminthology Laboratory |
| Trudy Inst. Genet. | Trudy Instituta Genetiki | Transactions of the Institute of Genetics |
| Trudy Inst. Gidrobiol. | Trudy Instituta Gidrobiologiya | Transactions of the Institute of Hydrobiology |
| Trudy Inst. Mikrobiol. | Trudy Instituta Mikrobiologiya | Transactions of the Institute of Microbiology |
| Trudy Inst. Okean. | Trudy Instituta Okeanologiya, Akademii Nauk SSSR | Transactions of the Institute of Oceanology, Academy of Sciences, USSR |
| Trudy Leningrad Obshchestva Estestvoisp. | Trudy Leningrad Obshchestva Estestvoispytatelei | Transactions of the Leningrad Society of Naturalists |
| Trudy Vsesoyuz. Gidrobiol. Obshchestva | Trudy Vsesoyuznogo Gidrobiologicheskogo Obshchestva | Transactions of the All-Union Hydrobiological Society |
| Trudy Vsesoyuz. Inst. Ekspt. Med. | Trudy Vsesoyuznogo Instituta Eksperimentalnoi Meditsiny | Transactions of the All-Union Institute of Experimental Medicine |
| Ukrain. Biokhim. Zhur. | Ukrainskii Biokhimichnii Zhurnal | Ukrainian Biochemical Journal |
| Urologiya | Urologiya | Urology |
| Uspekhi Biokhimiya | Uspekhi Biokhimiya | Progress in Biochemistry |
| Uspekhi Sovremennoi Biol. | Uspekhi Sovremennoi Biologiya | Progress in Contemporary Biology |
| Vestnik Akad. Med. Nauk SSSR | Vestnik Akademii Meditsinskikh Nauk SSSR | Bulletin of the Academy of Medical Science USSR |
| Vestnik Khirurg. im. Grekova | Vestnik Khirurgii imeni Grekova | Grekov Bulletin of Surgery |
| Vestnik Leningrad. Univ. Ser. Biol. | Vestnik Leningradskogo Universiteta, Seriya Biologii | Journal of the Leningrad Univ., Biology Series |
| Vestnik Moskov. Univ., Ser. Biol. i Pochvov. | Vestnik Moskovskogo Universitera, Seriya Biologii i Pochvovedeniya | Bulletin of the Moscow University, Biology and Soil Science Series |
| Vestnik Oftalmol. | Vestnik Oftalmologii | Bulletin of Ophthalmology |
| Vestnik Oto-rino-laringol. | Vestnik Oto-rino-laringologiya | Bulletin of Otorhinolaryngology |
| Vestnik Rentgenol. i Radiol. | Vestnik Rentgenologii i Radiologii | Bulletin of Roentgenology and Radiology |
| Vestnik Venerol. i Dermatol. | Vestnik Venerologii i Dermatologii | Bulletin of Venereology and Dermatology |
| Veterinariya | Veterinariya | Veterinary Science |
| Vinodelie i Vinogradarstvo | Vinodelie i Vinogradarstvo SSSR | Wine-Making and Viticulture |
| Voprosy Klin. | Voprosy Klinicheskie | Clinical Problems |
| Voprosy Med. Khim. | Voprosy Meditsinskoi Khimii | Problems of Medical Chemistry |
| Voprosy Med. Virusol. | Voprosy Meditsinskoi Virusologii | Problems of Medical Virology |
| Voprosy Neirokhirurg. | Voprosy Neirokhirugii | Problems of Neurosurgery |
| Voprosy Onkol. | Voprosy Onkologii | Problems of Oncology |
| Voprosy Pitaniya | Voprosy Pitaniya | Problems of Nutrition |
| Voprosy Psikhologii | Voprosy Psikhologii | Problems of Psychology |
| VoprosyVirusologii | Voprosy Virusologii | Problems of Virology |
| Vrachebnoe Delo | Vrachebnoe Delo | Medical Profession |
| Zav. Lab. | Zavodskaya Laboratoriya | Factory Laboratory |
| Zhur. Mikrobiol., Epidemiol. i Immunobiol. | Zhurnal Mikrobiologii, Epidemiologii i Immunobiologii | Journal of Microbiology, Epidemiology, and Immunobiology |
| Zhur. Nevropatol. i Psikhiat. | Zhurnal Nevropatologii i Psikhiatrii imeni S. S. Korsakov | S. S. Korsakov Journal of Neuropathology and Psychiatry |
| Zhur. Obshchei Biol. | Zhurnal Obshchei Biologiya | Journal of General Biology |
| Zhur. Vysshei Nerv. Deyatel. | Zhurnal Vysshei Nervnoi Deyatelnosti imeni I. P. Pavlova | I. P. Pavlov Journal of Higher Nervous Activity |
| Zool. Zhur. | Zoologicheskii Zhurnal | Journal of Zoology |

## ABBREVIATIONS MOST FREQUENTLY ENCOUNTERED IN RUSSIAN BIO-SCIENCES LITERATURE

| Abbreviation (Transliterated) | Significance |
|---|---|
| AMN SSSR | Academy of Medical Sciences, USSR |
| AN SSSR | Academy of Sciences, USSR |
| BIN | Biological Institute, Botanical Institute |
| FTI | Institute of Physiotherapy |
| GONTI | State United Sci-Tech Press |
| GOST | All Union State Standard |
| GRRRI | State Roentgenology, Radiology, and Cancer Institute |
| GTTI | State Technical and Theoretical Literature Press |
| GU | State University |
| I Kh N | Scientific Research Institute of Surgical Neuropathology |
| IL (IIL) | Foreign Literature Press |
| IONKh | Inst. Gen. and Inorganic Chemistry (N. S. Kurnakov) |
| IP | Soil Science Inst. (Acad. Sci. USSR) |
| ISN (Izd. Sov. Nauk) | Soviet Science Press |
| Izd. | Press |
| LEM | Laboratory for experimental morphogenesis |
| LENDVI | Leningrad Inst. of Dermatology and Venereology |
| LEO | Laboratory of Experimental Zoology |
| LIKhT | Leningrad Surgical Institute for Tuberculosis and Bone and Joint Diseases |
| LIPZ | Leningrad Inst. for Study of Occupational Diseases |
| LIPK | Leningrad Blood Transfusion Institute |
| Medgiz | State Medical Literature Press |
| MOPISh | Moscow Society of Apiculture and Sericulture |
| MVI | Moscow Veterinary Institute |
| MZdrav | Ministry of Health |
| MZI | Moscow Zootechnical Institute |
| LOKhO | Leningrad Society of Orthopedic Surgeons |
| NIIZ | Scientific Research Institute of Zoology |
| NINKhI | Scientific Research Institute of Neurosurgery |
| NIU | Scientific Institute for Fertilizers |
| NIUIF | Scientific Research Institute of Fertilizers and Insecticides |
| NIVI | Veterinary Scientific Research Institute |
| ONTI | United Sci.-Tech. Press |
| OTI | Division of Technical Information |
| RBO | Russian Botanical Society |
| ROP | Russian Society of Pathologists |
| SANIIRI | Central Asia Scientific Research Institute of Irrigation |
| SANIISh | Central Asia Scientific Research Institute of Sericulture |
| TsNII | All-Union Central Scientific Research Institute |
| TsNTL | Central Scientific and Technical Laboratory |
| VASKhNIL | All-Union Academy of Agricultural Sciences |
| VIG | All-Union Institute of Helminthology |
| VIEM | All-Union Institute of Experimental Medicine |
| VIR | All-Union Institute of Plant Cultivation |
| VIUAA | All-Union Institute of Fertilizers, Soil Science, and Agricultural Engineering |
| VIZR | All-Union Institute of Medical and Pharmaceutical Herbs |
| VNIRO | All-Union Scientific Institute of Fishing and Oceanography |
| ZIN | Zoological Inst. (Acad. Sci. USSR) |

Note: Abbreviations not on this list and not explained in the translation have been transliterated, no further information about their significance being available to us. - Publisher.